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PLATE III.

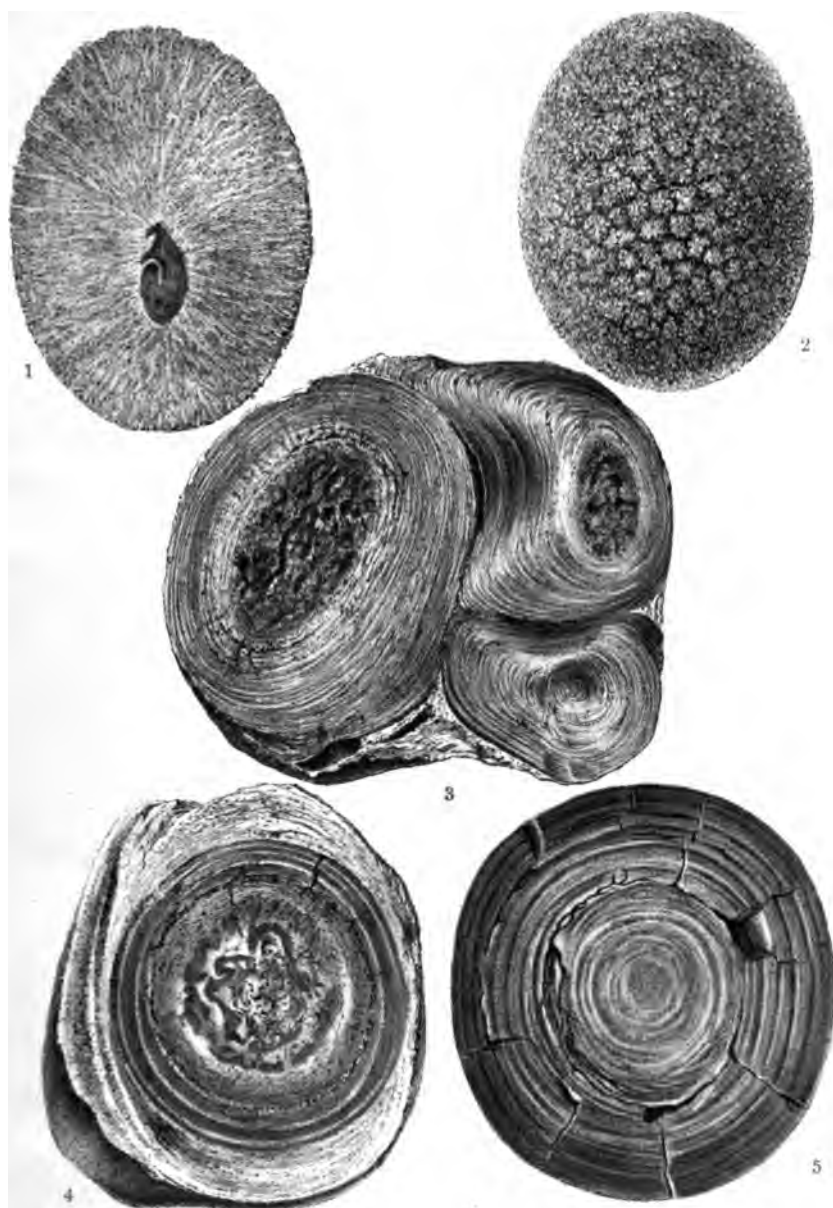


PLATE III.

Fig. 1.—Section of Cystic Oxide Calculus.

Fig. 2.—External Surface of the Same.

Fig. 3.—Section of a large Uric Acid Calculus, consisting of three distinct Calculi united by a deposit of earthy phosphates.

Fig. 4.—Calculus representing an abrupt transition from a Uric Acid to a Phosphatic Deposit.

Fig. 5.—Section of a Uric Acid Calculus.

A

SYSTEM OF SURGERY

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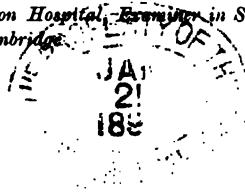
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SYSTEM OF SURGERY.

XXXIV. INJURIES AND DISEASES OF MUSCLES AND TENDONS.

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I. INJURIES OF MUSCLES AND TENDONS.

Laceration or section of muscle or tendon.—The skin being divided or lacerated by a sharp instrument, or by a heavy blow from a blunt one, the subjacent muscular or tendinous structures may be also cut through. The appearances presented by the divided surfaces vary with the characters of the implement which produced the injury.

The **diagnosis** of the conditions present is usually readily arrived at; or is, at least, easily determined by increasing the length of the wound in the skin.

Treatment.—If the muscular or tendinous structures are divided along their length, and no separation of parts exists, no special surgical measure is required. The treatment of these wounds depends largely on the implication of a synovial membrane and on the presence or absence of septic infection.

In most cases the wisest course to pursue, after endeavouring to render the injured tissues aseptic, is to bring the divided surfaces of muscle or tendon into accurate apposition, and by means of some splint or apparatus to retain the part in such a position that a minimum strain is exerted upon the sutured structures.

It is sometimes necessary, especially in the case of tendons, to divide sheaths and ligaments freely, in order to follow up the retracted divided ends, and to ensure that the respective portions are well united to one another. Much difficulty may be experienced in doing this; for example, when the flexor tendons of the hand have been divided immediately above the anterior annular ligament, the

fingers being flexed at the time, much retraction of the distal fragments occurs.

No pains should be spared to ensure as accurate an apposition

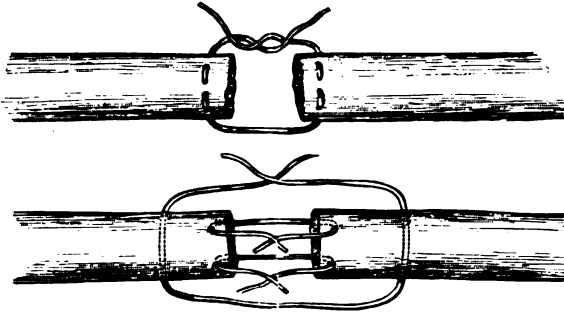


Fig. 464.—Methods of Uniting Tendon. (Duplay and Reclus.)

as possible of the surfaces. The best material to use is twisted silk, and the finer the silk the better. Figs. 464, 465, and 466, illustrate several methods that may be adopted with advantage, not only for

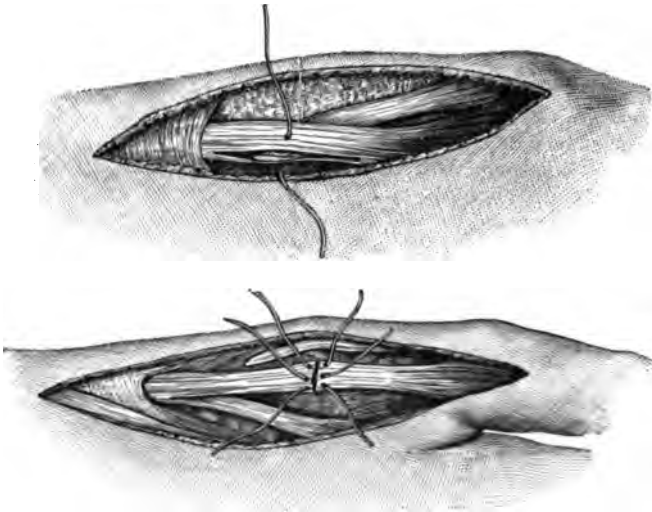


Fig. 465.—Methods of Uniting Tendon. (Duplay and Reclus.)

suturing tendons, but also muscular structures. If after suturing there exists any uncertainty as to perfect asepsis having been attained, or, if powerful irritating germicides have been used freely, sterilised iodoform gauze should be packed around the damaged structures, so as to secure as thorough drainage as possible

When the tissues are much lacerated, bruised, and fouled, no attempt should be made to suture the cut surfaces for a few days, till, by careful cleansing and packing, the wound has been rendered aseptic.

It is often advisable loosely to connect corresponding structures temporarily with silkworm gut, as at a later period some difficulty may be experienced in differentiating them.

When the damage is even more extensive, and the wound very generally infected—after all crushed and hopelessly lacerated structures, whether muscular or tendinous, have been removed—the parts should be carefully cleansed, and packed with gauze soaked with sulphur and glycerine. This plug should be removed at the end of twenty-four hours, when the recently damaged structures which have been in contact with the gauze will be found blackened and sloughy on the surface, but free from micro-organisms. Daily irrigation and packing with sterilised gauze will produce a very satisfactory result. At any period after the wound has been thoroughly cleansed, an attempt should be made to secure apposition of the divided and separated surfaces.

Though the treatment of such cases is frequently very disappointing, owing to the amount of fixation of the tendons, which too often results, yet it is remarkable what improvement may take place, in apparently the most unsatisfactory cases, by the application of vigorous manipulation for a considerable period of time.

Rupture of muscle or tendon.

Causes.—Subcutaneous rupture of a healthy muscle or of its tendon may result from the quick and unexpected contraction of the muscle, or from sudden and severe strain being exerted upon it while tonically or firmly contracted. The *congenital hæmatoma*, due to rupture of the sternomastoid muscle, forms an excellent example of this last mode of causation. A muscle or its tendon may also be ruptured by direct violence, as by a blow with a stone or heavy instrument. Such an accident occurs more readily when the muscle or aponeurosis is spread out in a thin layer over a bone, as in the case of the skull, but will occur also in the muscles of the extremities, as in the vasti muscles of the thigh.

Such injuries, whether arising from the sudden contraction of a muscle, from prolonged stretching, or from direct injury, occur much

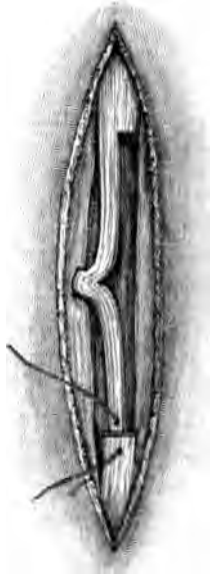


Fig. 466.—Method of Uniting Tendon. (Duplay and Reclus)

more readily in debilitated subjects, or in those in whom the muscle-fibres have undergone vitreous, waxy, or fatty degenerative changes during typhoid, small-pox, and other infectious fevers. When such conditions are marked, rupture of the muscle may result from some trifling voluntary, reflex, or spasmodic movement. Alcoholism, general obesity, old age, rheumatism, syphilis, locomotor ataxy, and excessive fatigue have all been regarded as causes predisposing to rupture of muscle or tendon.

Bones and tendons are ruptured much more readily than muscles. It has been calculated that rupture of the belly of the biceps femoris is eight times less frequent than rupture of its tendon.



Fig. 467.—Rupture of the Inner Head of the Biceps Humeri.

Rupture of a muscle or of its tendinous portion may be *partial* or *complete*, the former occurring more often than the latter. As one would expect, the muscles of those who are unaccustomed to violent exercise rupture more readily than do those of men leading a continuous active existence.

The large majority of ruptures of muscle in the healthy subject are due to sudden effort, as an attempt to retain the erect posture in a fall, or to lift a very heavy weight, or to push a heavy load, or to such violent muscular efforts as are made in parturition, eclampsia, delirium tremens, or mania.

The **muscles usually ruptured** are the abdominal muscles, the quadriceps extensor cruris, the adductors, the biceps femoris, the tibialis posticus, the gastrocnemius, the pectoralis major, the deltoid, the biceps humeri, the rhomboid, the trapezius, and the erector spinæ.

The long head of the biceps, like the tendon of the supraspinatus muscle, may be gradually divorced from its attachment by the ascent of the head of the humerus, which takes place particularly in that variety of osteo-arthritis of the shoulder joint which may be termed "mechanical or traumatic arthritis," since it results from injury, occupation, or old age. In the progress of this condition a sudden forcible contraction of the biceps muscle may result in the rupture of the already partly-divided tendon, its acquired attachment to the bicipital groove and its vicinity being insufficient to bear the strain. Fig. 467 represents a rupture of the inner head of the biceps in the arm of a professional boxer.

Symptoms.—If the rupture of a superficial muscle be recent, there may be no obvious gap between the torn portions, owing to the interval being filled up with extravasated blood. When, however,

this material is absorbed the separation becomes obvious, especially during voluntary contraction of the muscle, when a prominence forms on either side of the depression. If the rupture be partial and deep-seated, there may be no evidence of its existence beyond the sudden local pain experienced after some unexpected and more or less violent voluntary or reflex movement, associated with an inability to use the muscle as freely as before. Swelling and stiffness appear at the injured part, and, later, some discoloration of the skin may arise, due to the diffusion of the extravasated blood. Rupture of muscle is much more painful than rupture of tendon. The pain felt when muscle fibres are ruptured is peculiar. It is a pain so sharp and well localised that the patient often thinks he has been struck by a stick or stone. This is especially the case when muscle fibres are ruptured in the calf of the leg; and the French term *coup de fouet*, as applied to this sharp pain, is very graphic.

In some instances the part which is the seat of the rupture becomes alarmingly swollen and tense, a symptom that is also perhaps most marked when the injury is in the calf.

Treatment.—Complete rupture of muscle is often followed by a considerable separation of the segments, and much loss of power, so should a suspicion of such a sequel arise, the surgeon may be justified in cutting down on the damaged part, and bringing the torn surfaces into as good apposition as possible by sutures.

The form of suture used must vary with the condition of the muscle. If it be pretty firm, ordinary silk sutures, interrupted or continuous, will serve to bring the ruptured ends into apposition. If these sutures tend to tear out, the lacerated ends may be made more resistant by passing a silk suture backwards and forwards through the muscular tissue, parallel to its torn edge, and about half an inch beyond it. These transverse threads will enable the sutures connecting the ends of the muscle to retain their grip upon the torn tissues. (See Fig. 464.)

In the case of partial rupture of a muscle, the part should be kept at rest and should be lightly fixed in such a position as to approximate the divided ends and prevent action of the muscle.

In the case of a rupture in the lower limb the patient had better rest in bed for a week or ten days, until the swelling—which may be considerable—has subsided. He may then move about with the part suitably supported, taking care that the affected muscle is not brought into action. Thus, after rupture of muscle fibres in the calf, a man will walk for some time with the foot rotated out, and will move the limb from the hip only, walking mainly on the heel. As soon as the severe pain has subsided, recovery may be hastened by friction and manipulation of the part. Stiffness, and, in the lower limb, œdema, may persist for many months after the accident, and in the case of the leg or thigh massage of the part may be assisted by the support of a stockinet bandage.

In rupture of a tendon it is usually sufficient to retain the part in such a position that the points of attachment of the

affected muscle are approximated as much as possible. This may be done by plaster cases—as Croft's—or by suitable wooden or metal splints.

Occasionally the torn ends may form new attachments, and so produce much mechanical depreciation, and sometimes it may seem advisable to cut down upon the ends, to separate them from their acquired attachments, and to establish continuity. This may frequently be facilitated by dividing the muscle or its tendon subcutaneously at a distance from the point of suture.

Pathology.—Union of the two segments of a muscle takes place by fibrous tissue, the amount and extent varying with that of the rupture and of the interval remaining. Some striated muscle fibres develop in the cicatrix, but there is much difference of opinion as to their mode of origin. Some observers assert that these newly-formed muscle fibres undergo degenerative changes, and become reabsorbed, taking no share in the formation of the permanent cicatrix.

Suppuration very rarely follows rupture of a muscle. It is believed by some surgeons to occur not very uncommonly in the psoas muscle after an injury to it.

If a portion of inflamed muscle be examined microscopically, the division of the nuclei of the muscle fibres is seen very distinctly. The sarcois substance is cloudy and granular, has lost its striation, and is disintegrating. The nuclei assume embryonic characters, and resemble the nuclei of the cells of a growing sarcoma, being surrounded by a little protoplasm.

It occasionally happens that the damaged tissues may develop syphilitic or tuberculous conditions, and these are liable to the same changes as similar affections of other parts.

Healing of a tendon.—The mode in which union takes place in subcutaneous rupture of a tendon is described in the following, which Mr. A. H. Tubby has very kindly abstracted for me from his paper in the Guy's Hospital Reports for 1892, entitled "The Regeneration of Fibrous Tissue."

The essential points are the disappearance of red blood corpuscles and fibrin, and, later, of white corpuscles, following the appearance of plasma cells in the effusion. From the plasma cells arise immediately two other kinds of cells—vasoblasts and fibroblasts. The former join end to end, and define the channels for the new vessels in the scar; the latter directly elongate and form fibrous tissue. When obliteration of the vessels of the scar takes place, the vasoblasts also elongate into fibrous tissue.

Third day. The red blood corpuscles are disappearing from the effusion, and in the latter are seen numerous longitudinal vacuolations. Plasma cells, which have migrated from the tendon owing to the stimulus produced by the injury, are seen in the effusion. Some of the plasma cells are arranged around the vacuolations, and form the walls of the future blood-vessels of the scar; others are seen in clumps in the effusion, especially at those spots where leucocytes are

abundant. It would seem that their growth and multiplication are effected at the expense of the leucocytes, which they absorb, so that leucocytes have no direct share in the formation of scar tissue. The ends of the tendon show the fibres separated by aggregations of plasma cells; and it is by the development of such cells into fibrous tissue that the dovetailing of old and new material takes place.

Seventh day. The red blood corpuscles have almost entirely disappeared, and the leucocytes are scanty; the sheath is much thickened and shows numerous large vessels. Many of the plasma cells are becoming elongated and tailed.

One month. Complete vascular connection has now been made between the inter-fascicular vessels of the tendon and the new vessels in the effusion. With this the transformation of plasma cells into fibrous tissue is proceeding apace.

Three months. The blood-vessels in the scar are disappearing, and the cells lining them are becoming converted into fibrous tissue.

Eight months. The uniting material closely resembles normal tendon, except that the fibres in the uniting material are not strictly parallel, and there are no fixed tendon cells.

Thirteen months. The scar has not yet assumed the appearance of normal tendon, although there is evidence to show that it may do so, as the process is not complete: *i.e.* complete regeneration is possible.

Congenital hæmatoma of the sterno-mastoid.—This is the term commonly applied to a mass or tumour found in the sterno-mastoid muscle of infants, and inseparably connected with it.

Causation.—It was called formerly chronic “induration of the sterno-mastoid,” or “sterno-mastoid tumour,” and was at one time regarded as being syphilitic in origin.

Recent investigation has shown that it consists in a partial or complete rupture of the sterno-mastoid muscle, the torn muscle undergoing repair in the usual manner: namely, by the formation of a fibrous cicatrix, which, by its contraction, may produce a variable amount of shortening of the damaged muscle and the condition called torticollis.

It is almost always produced by strain during the birth of the child; but it is said that it may result from an injury sustained by the fœtus while still in the uterus.

It is seen most frequently in difficult labours, and in head presentations, especially when forceps have been used.

Relation to torticollis.—Much difference of opinion has existed among surgeons as to the frequency with which torticollis follows damage to the sterno-mastoid muscle. Some surgeons, as Petersen and Weiss, have asserted that congenital torticollis never results from rupture of this muscle; and others, as Stromeyer and Dieffenbach, believe that torticollis is invariably produced in this manner. As Mr. D'Arcy Power has shown in a recent paper in the Transactions of the Royal Medico-Chirurgical Society, the truth lies between these two extremes, since out of 106 cases of congenital hæmatoma which

he collected, 20 died too soon for wryneck to have become apparent ; in 47 wryneck was not looked for ; in 25 cases it occurred, in 4, however, only slightly ; and in 14 it was looked for and not found : so that well-marked wryneck occurred in at least 21 cases out of a total of 106 recorded cases of congenital hæmatoma.

Out of this number the swelling was situated in the upper and middle parts of the muscle in 22, in the lower part in 13 ; in 1 the whole muscle was affected, while in the remainder no mention was made of the locality of the tumour. The right sterno-mastoid was the seat of the injury in 47 cases, the left in 36, and in 5 it was bilateral.

Facial asymmetry is very rarely present in torticollis following on congenital hæmatoma. These tumours remain in existence for many months, disappearing gradually.

Diagnosis.—It is probable that the condition which most readily simulates congenital hæmatoma is enlargement of the lymphatic glands beneath or in the vicinity of the sterno-mastoid. The hæmatoma is, however, inseparable from the muscle with which its outline blends above and below. It varies somewhat in shape, being sometimes fusiform, and sometimes irregular and nodular. It is dense and hard after it has existed for some weeks, but in its early stage it may feel firm and fleshy. Whether a gumma of the sterno-mastoid ever exists in infancy is very doubtful.

Treatment.—Any tendency to the development of torticollis should be carefully looked for and opposed. This may be done by frequent manipulation, or in later stages by means of a collar or double felt splint supporting the chin and occiput, the parts of the apparatus being connected by straps on either side. By altering the strain on these lateral straps, and by varying the form of the splints by means of padding, etc., considerable tension may be exerted upon the contracting muscle. In fully-developed cases it may be necessary to divide one or both bellies of the sterno-mastoid, or even to excise part of the muscle.

Hernia of muscle.—There are two fairly distinct varieties of this injury—namely, the true form and the pseudo-hernia.

The *true form* is due to a yielding or tearing of the fascial covering of the muscle and the protrusion of the muscle through the rent. It is very rare, and is a condition which is produced gradually by a repetition of violent muscular efforts, such as may occur in riding and in some very laborious occupations.

Pseudo-hernia, which is much more frequently met with, is produced suddenly by a violent effort, by a fall, or by a blow. It results from a rupture of the muscle, together with its fascial sheath, one or both torn ends protruding through the rent in the sheath. It may appear as two tumours separated by a depression, or as a single prominence. In either case the mass is soft, and easily reducible, when the aponeurotic aperture can be readily felt. During voluntary contraction of the affected muscle the herniated mass becomes larger and harder.

In the true variety the patient discovers a rounded mass, which gradually increases in size, without any more definite after-symptoms than a feeling of weakness or want of power. If the muscle be rendered tense by a passive movement of the limb, the swelling subsides or disappears. Forcible voluntary contraction causes it to become hard and to diminish slightly in bulk. If the voluntary movement be opposed, the tumour disappears completely.

The abdominal muscles and the adductors of the thigh are those most frequently affected.

Treatment.—In most cases the patient gains much relief from pressure applied by some form of bandage or apparatus. Where this is unsuitable, the edges of the fascial aperture may be freshened, and brought accurately together by a continuous silk suture. In the pseudo-variety the ends of the muscle and the fascial edges may sometimes be united by a plastic operation with great advantage.

Dislocation of a tendon.—This is a comparatively rare accident. Some surgeons of large experience—as, for instance, Gosselin—have never seen it. By the term dislocation is understood the displacement of a tendon from its normal groove or channel. The tendons most commonly displaced are those of the peroneus longus and brevis muscles, the anterior and posterior tibial tendons, and the long head of the biceps in the arm. The dislocation results from a sudden and violent contraction of the muscle, when the limb is placed in such a position as favours the displacement.

The injury is accompanied by much local pain, by swelling, by more or less disablement, and by obvious impairment of the action of the involved muscle. The displaced tendon can be readily felt and usually replaced with facility in its normal position. The greatest difficulty may, however, be experienced in retaining it in its original place.

By means of a combination of local pressure, and the fixation of the part in a suitable position for many weeks, a successful result may follow; but as a rule, the tendon very readily becomes displaced, even after the most careful treatment. In some cases a better result might be obtained by cutting down upon the displaced tendon, replacing it in its normal position, and retaining it there by suturing the torn edges of its sheath firmly and accurately together with buried fine silk sutures.

II. DISEASES OF MUSCLES AND TENDONS.

Rheumatic myositis.—This term is applied to a painful inflammation of the muscular, tendinous, and aponeurotic structures of the body.

Symptoms.—The extent of the trouble is very variable, a part of a muscle, the entire muscle, or a group of muscles may be affected. The patient experiences great pain on movement, and on pressure being made upon the affected part. The trouble usually lasts but a few days, but may be more chronic in some cases.

It is spoken of as *lumbago* when it affects the lumbar and lower spinal muscles, as *pleurodynia* when the intercostal muscles are involved, as *rheumatic torticollis* when the cervical muscles are affected, and when in the muscles of the scalp as *rheumatic cephalalgia*.

Treatment.—Rest, stimulating applications, with warmth, massage, salines, iodide of potassium, and salicylate of soda are all useful.

Myositis ossificans.—In this rare disease masses of bone form in the several muscles.

Causation.—The male sex is much more liable to this affection than the female, since out of twenty-four cases four only occurred in the latter. It usually arises in early life. Out of twenty-two cases collected by Pinter, in fifteen the disease started before fifteen years of age, and in seven after that age.

Injury sustained at birth or subsequently, hereditary predisposition, and syphilis have all been regarded by various observers as factors determining its development. By others it is regarded as the result of an inflammation of the parenchyma of muscle. In a case shown at the Clinical Society in 1886, by Mr. Simpson—of which Figs. 468 and 469 are illustrations—the boy gave a history of a fall upon the right shoulder fifteen months before. This was followed by the formation of a painful swelling over the scapula,



Fig. 468. — Myositis Ossificans. (Mr. Simpson's case.)

which gradually shrank; and three months afterwards a similar swelling formed over the left scapula. In this case, as in another shown by Mr. Godlee in the same year, there was a peculiar deformity of the metatarso-phalangeal joint in both great toes, the articulation being enlarged and displaced inwards, and the great toe being turned outwards. In both cases this condition was congenital. It has been described in other instances besides these. This deformity is shown in Fig. 469.

Pathology.—It would appear that the process of ossification does not start in the muscle fibre itself, but affects the connective tissue of muscles, tendons, and aponeuroses. If a bony mass be removed, the transition from a cellular infiltration to the formation of fibrous

tissue and of true bone can be readily traced. Sometimes the bony masses are continuous with the skeleton, but at other times not. In no case does a muscle ossify in its entirety. No change has been found in the nervous system in connection with this affection.

Symptoms.—The disease starts usually in the dorsal region, and its development is associated with little or no trouble other than the progressive discomfort caused by the limitation of movement, and the awkward position which the patient is obliged to assume. The head is kept bent forwards, and usually to one side, and it cannot be raised to the erect posture. Abduction of the arms is permitted only to a limited extent. The whole length of the spinal column is rendered rigid, and is often flexed on the pelvis or deflected to one side.

Masses of bone form in the muscles of the back, sometimes independently of one another and of the bony attachments of the muscles, and at other times in apparent continuity with the latter. The muscles most commonly and most extensively affected are the latissimus dorsi, the trapezius, the muscles on the back and side of the neck and the erector spinæ. The muscles on the front of the body and of the limbs are attacked at a later stage. In many places it will be noticed that the bony plates, bars, or masses have transgressed the limits of the muscles involved.

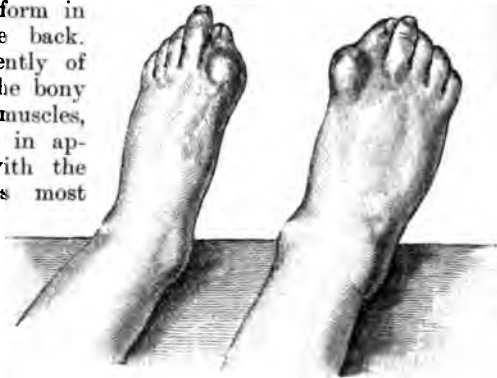


Fig. 469.—Myositis Ossificans. The deformities of the metatarsophalangeal joints.

Though the disease is progressive, it does not increase uniformly and steadily, but by fits and starts. Attacks simulating a more or less acute inflammation of a muscle develop, and a large diffuse brawny mass is formed, which almost suggests the presence of an infiltrating growth, and is accompanied sometimes with enlargement of the adjacent lymphatic glands. As this swelling subsides, movement of the affected part is found to be more limited than before, and new bony plates can be seen or felt. Neuralgia is not uncommon.

At a later stage of the disease many of the articulations may be rendered completely fixed, and an ankylosis of the temporo-maxillary articulations in a position of extreme flexion may render it necessary to feed the patient by artificial means.

Prognosis.—The disease almost always terminates fatally. It is said to have an average duration of about ten or twelve years.

Death usually results from pulmonary complications, due to the progressive limited capacity of respiration.

Trouble may also arise from inflammation of the skin over prominent masses of bone, due to pressure.

Diagnosis.—In its earliest stage myositis ossificans may simulate spinal caries. The masses, which develop acutely at intervals, may be mistaken for gummatous, tubercular or inflammatory formations. The presence of the bony masses will soon serve to elucidate the condition.

Treatment.—Little or nothing can be done to stay the progress of the disease. The removal of a prominent piece of bone, over which the skin is stretched, or of an osseous mass, which interferes with some important movement of the patient, may at times add considerably to the general comfort and well-being. The careful guarding of the prominences of bone from pressure, and from the consequent development of sores, and the avoidance of conditions likely to set up pulmonary trouble, are also advisable.

Iodide of potassium has been administered very freely, but apparently without much benefit.

Ossification of muscle or tendon.—There are several modes in which bony masses may develop in muscle or tendon.

(1) Habitual and excessive strain upon a muscle, ligament, or bone, arising in consequence of occupation, or due to such an injury as will cause the mechanism of the affected part to vary from the normal, may result in the formation of bone in the muscle or tendon involved.

That the bones themselves, in obedience to this law, are very largely dependent for their form upon the traction to which their several parts are habitually exposed is shown very well by contrasting Fig. 470 A and B, which represent respectively the posterior aspects of the scapulæ of a shoemaker, and of a labourer whose chief duty was to carry loads on his shoulder.

(2) Again, a mass of bone may project from a part of the skeleton to perform some mechanical function which would be advantageous to the comfort and well-being of the individual. This is illustrated very well by Fig. 470 C, which represents the anterior surface of the atlas of a shoemaker, showing the formation of a bony growth in the substance of the rectus lateralis, continuous below with the lateral mass of the atlas, and above forming an arthrodial joint with the under surface of the jugular process of the occipital bone.*

(3) Occasionally masses of bone are found in human subjects, which are retrocessions to ancestral types; as, for instance, the supra-condyloid process on the humerus and the gluteal trochanter on the femur.

(4) Again, sudden injury producing partial rupture, or bruising of a muscle, either at one period or on several occasions, associated

* See *Journal of Anatomy and Physiology*, vol. xxvii.: "The Anatomy and Physiology of the Shoemaker."

or not with the exercise of habitual strain upon the damaged muscle, may result in the formation of bone in it.

The formation of a mass of bone in one of the adductor muscles is said to occur in cavalry soldiers, and has been called the "rider's-bone" (the Reiterknochen, of Billroth). It is supposed to arise in consequence of injury sustained while endeavouring to retain the grip of the saddle. It occasionally follows a partial rupture of one of these muscles, as in a case described by Mr. Birkett, in the Guy's Hospital Reports for 1868. The bony growth lies, as a rule, in the substance of one of the muscles, where it can be readily felt, and

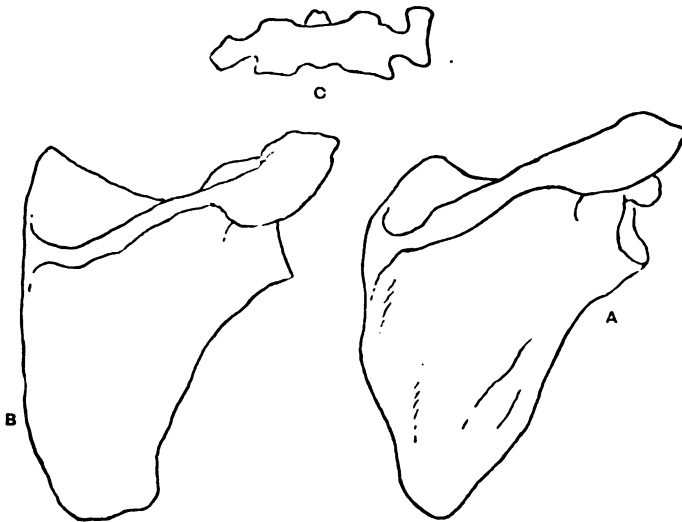


Fig. 470.—A, Scapula of shoemaker; B, scapula of deal porter; C, atlas of shoemaker.

occasionally it extends along the tendon, from its bony attachment. These growths sometimes render riding and, later, even walking, difficult and even impossible. In such cases the growth has been removed and the patient relieved of his discomfort.

(5) "Exercise bone" is the name given to a mass of bone formed in the substance of the left deltoid muscle in foot soldiers. It is supposed to be due to the irritation set up by the pressure which is exerted by the rifle in certain exercises.

Syphilitic affections of muscles. *Myalgia*.—During the secondary stage of syphilis the patient frequently suffers from a dull pain in his muscles, which is much increased by their contraction or by pressure. It is sometimes distributed generally, and at other times limited to a portion of a muscle. It is usually worse at night and in the early morning. The thighs, calves, and loins are most frequently affected. The myalgia subsides spontaneously, but not infrequently relapses. It yields readily to remedies.

Debility and wasting are not rare, and affect the female more frequently than the male. They are both usually concomitant and temporary in character, disappearing under specific treatment.

Tremor.—Fournier describes as a rare phenomenon of early syphilis in women a peculiar tremor affecting the muscles of the fore-arms, rarely extending to the lower extremities. The attack comes on suddenly and continues for a few hours, rarely for a whole day. The liability to it usually lasts a few weeks. The tremor consists in a succession of rapid jerks.

Contraction.—Contraction of one or more muscles may occur during the secondary stage, and less frequently during the tertiary. It usually appears between the sixth month and the end of the first year. The contraction develops slowly. There is a gradually progressive limitation of movement of the joints controlled by it, associated with a stiffness, or a feeling of pain or discomfort in the muscle, which becomes larger, harder, and less resilient than normal. On stretching it, it yields a little, pain being experienced, and on the strain being withdrawn it returns to its contracted condition. Electrical reaction is more or less diminished, and varies with the degree of contraction. Voluntary contraction is unassociated with pain.

The biceps is affected more frequently than any other muscle, but the biceps femoris, the semi-tendinosus, the sterno-mastoid, and the trapezius, may also be affected.

The contraction may last several months, or even years, when it gradually disappears.

As to the pathological changes which produce this condition little is known definitely, beyond that a certain small number develop in consequence of a syphilitic myositis, or of a gumma in the substance of the muscle. The affection yields readily to anti-syphilitic remedies. It is distinguished from gumma by the absence of any abnormal swelling, and by the early period of onset. It may simulate disease in the joint, which, however, is free from pain or swelling.

In **tertiary syphilis** the muscles of the extremities especially are liable to two forms of *myositis*. The more common is a *sclerosing myositis*, while the other is due to the formation of a gumma in the substance of a muscle. They are both varieties of the same morbid process, and the gumma is rarely present alone. Perhaps the muscles of the tongue afford the most ready situation for the observation of these two conditions, and of the changes which result from them.

In the case of the *sclerosing myositis* the muscle is increased considerably in bulk by the diffuse change in its interstitial tissue, while later it is diminished in size, and rendered hard and resistant by the cicatricial contraction of the fibrous tissue which is developed, and the associated destruction of the muscle fibres, which degenerate, lose their striation, and fill with oil globules. Caseation and calcification may ensue finally. The swelling is hard, and does not

fluctuate. The muscle is more or less fixed, and its extension is painful or impossible. The patient experiences an aching pain in the part. The muscles of the limbs are those most frequently affected.

In its early stage complete recovery takes place under treatment, but in the cicatricial stage no benefit is obtained.

The *gumma* forms a hard oval painless mass in the substance of the muscle, presenting an outline that is usually well defined. They are rarely single. Not uncommonly these tumours are multiple within quite a small area. Eight or ten may occasionally be felt in the substance of the tongue. On section, they are clearly circumscribed, greyish-yellow or whitish in colour, and gelatinous, caseous, or fibrous in structure. Gummata in muscles, as elsewhere, if untreated, are liable to undergo necrotic changes, and in old people the ragged deeply undermined ulcers that result may assume in the mouth or pharynx an epitheliomatous character. Less frequently, cicatricial contraction results.

In either case the muscular mechanism, which is the seat of the sclerosing myositis or of the *gumma*, whether it breaks down or cicatrises, is depreciated to a variable extent by it.

The symptoms presented are those of a tumour, which is fixed when the muscle is contracted. Pain is rarely present, but when it exists it is nocturnal, or increased at night.

The diagnosis between *gumma* and tumours of the connective tissue, or epithelial type, is determined very rapidly by treatment.

The result of treatment depends obviously to a large extent on the stage at which drugs are commenced.

Contraction of muscles and fasciæ.—Muscles, tendons, and fasciæ which have been permitted to remain relaxed and unexposed to tension for a considerable period of time can often no longer be extended to their normal length.

This occurs occasionally when a part, such as the fore-arm and hand, has been fixed immovably on a splint for an excessive period of time, because of a fracture of one or both bones of the fore-arm, the fingers being retained in a position of flexion. On attempting to extend the fingers and wrist in such a case, the resistance which is offered by the muscles and tendons is in many cases so great as to permit of no movement whatever.

Treatment.—In some cases much benefit may be derived from manipulation, extension, and the use of splints, by which traction or pressure may be applied in order to overcome the contraction. In severe conditions, the subcutaneous section of tendons may be of some service, but even from this but little benefit may be derived. It is advisable not to divide all the tendons at the same level, but to sever them separately, and at a distance the one from the other. If the fascia obviously opposes extension, it should be divided also; and the same applies to ligaments, which readily shorten and become fixed in the contracted position.

A like condition arises where a joint is, during some long

illness, or on account of some painful condition, retained for a long period of time in a position of flexion.

In such a case traction, assisted by massage, manipulation, and the subcutaneous section of muscular, tendinous, fascial, or other structures opposing extension, may remove the disability more or less completely.

In many cases treatment, however thorough, is of but little use in restoring the parts to their original freedom of movement.

Deformities resulting from atrophic changes in muscles, whether due to disease of the cord or to damage to or disease of the nerves, hardly come under this heading, and will be referred to elsewhere (page 58).

Atrophy of muscle.—This condition may result from a lesion of the anterior cornua of the cord, or of the nerves supplying the affected muscles. In certain cases it may be due to some idiopathic condition of the muscle itself.

The following table, with remarks on the reaction of degeneration, from Dr. Frederick Taylor's work on Medicine, serves briefly to elucidate the causation of the several conditions:—

Varieties.—*Myelopathic : Diseases of anterior cornua.*

(a) Acute: Atrophic spinal paralysis, or acute poliomyelitis.

(b) Chronic { Protopathic : Progressive muscular atrophy.
Deuteropathic : Amyotrophic lateral sclerosis.
Hypertrophic cervical meningitis.
Atrophy following locomotor ataxy.
Atrophy following disseminated sclerosis.

By “protopathic” is understood disease commencing in the anterior cornua of the spinal cord; by “deuteropathic” disease of the cornua brought about by extension from changes in other parts as the lateral columns, posterior columns, or meninges.

Neuropathic : Diseases of nerves.

(a) Acute: Injury.

(b) Sub-acute: Neuritis.

(c) Chronic: Compression, Hypertrophic cervical meningitis.

Myopathic : Diseases of muscle.

Pseudo-hypertrophic paralysis, Idiopathic muscular atrophy.

The reaction of degeneration, expressed for convenience as R.D., affords the most important clinical evidence of the existence of a disease affecting the nerve nuclei, nerve trunk, or muscles.

Complete R.D. consists of loss of excitability in the nerve to both faradic and galvanic currents; loss of excitability in the muscle to the faradic current, increased excitability in the muscle to the galvanic current, with qualitative or polar changes and sluggish contractions.

In incomplete forms of R.D. the reaction of the muscle to galvanism is as just described, but the excitability of the muscle

to faradism, and of the nerves to either, is not lost but only lowered.

A mixed variety is also described, in which the muscle contractions to galvanism are neither very sluggish nor very prompt. It occurs where degenerated fibres of muscle or of nerve lie side by side with others that are healthy.

Anatomical changes.—The anatomical changes presented by the muscles in the various diseases referred to vary considerably; for instance, in progressive muscular atrophy the muscles are pale and small, the fibrillæ are found more or less degenerated, being diminished in size or with striation, which is indistinct or replaced by fatty granules. Sometimes there is longitudinal striation, and sometimes waxy or vitreous degeneration.* The connective tissue of the muscle is increased in quantity.

In pseudo-hypertrophic paralysis the muscles are large, and look like masses of fat. The muscle-fibres are thinly scattered about in fat and fibrous tissue.

Atrophy from disuse.—Besides the atrophic changes just described, a muscle may waste and undergo a considerable amount of fatty change from want of use. This is partly the cause of the wasting in muscles about a chronically diseased joint. Again it may occur in muscles which have ceased to perform any function, as, for instance, the muscles which act upon a joint that has become fixed by disease or operation.

In fatty degeneration the structure of the fibre is altered by the fatty granules; and in the intervals between the fibres fat cells are developed in considerable quantity, the muscle cell finally disappearing.

Tumours of muscles and tendons.—Muscles may be affected by primary growths, by direct extension from a neighbouring growth, and by secondary or metastatic tumour deposits.

Carcinoma.—The various forms of carcinoma may involve and destroy any muscular structure with which they may come into relationship. Familiar examples of this are afforded by the extension of cancerous growths in the breast to the pectoral and intercostal muscles; and in the cases of epithelioma of the lip or tongue by the implication and destruction of the muscles of the face and of the tongue by the spreading growth.

Again, a metastatic or secondary carcinomatous focus may form in a muscle at a considerable distance from the primary growth.

Carcinoma never develops primarily in a muscle.

Sarcoma.—Primary sarcoma of muscle is comparatively rare. Many of the sarcomata invade muscle by direct extension or by the formation of secondary foci.

Sarcomata affect tendons and tendon sheaths both in their fibrous and synovial structures. When the fibrous or synovial walls of the

* In vitreous or waxy degeneration the muscle-fibres lose their striation and nuclei and become converted into masses of a colourless, homogeneous, glistening substance. It occurs after acute diseases, as typhoid, etc.

sheaths are affected, as in the case of the flexor tendons of the palm, much doubt may arise as to the diagnosis. Fig. 471, which represents a tuberculous focus of disease in the synovial membrane of the flexor sheath, illustrates quite as well the appearances presented by a sarcoma which was removed from the tendon sheath of the same finger of a young girl.

Sarcomata of the tendon sheaths frequently contain remarkably good specimens of giant cells.

Innocent tumours.—*Angeiomata*, *fibromata*, *fibro-chondromata*, *myxomata*, or *lipomata* are occasionally found developing in the connective tissue between the bundles of muscular fibres.

Lipomata are found often in the hands and feet beneath the fasciæ, where they simulate sometimes very closely either of the varieties of tubercular teno-synovitis. Some of these tumours are connected with the exterior of the tendon sheaths; some of them are arborescent in form; but they are all very soft, and often yield to the fingers a sensation closely resembling fluctuation. In many cases an exploratory operation is required to determine the character of the tumour.

Fibromata of tendons or their sheaths are rare. They occur mostly in the hands, are usually soft, and in rare cases are attached to the tendons themselves.

Hydatid cysts not infrequently form large rounded tumours in or between muscles.

As described elsewhere, a *gumma* may commence in a muscle, or the muscle may be involved in a gummatous process set up in an adjacent structure. Such tumours, if neglected, may soften and form excavated deep ulcers, with sloughs, which are perfectly characteristic in appearance.

Tubercle, again, may involve muscle primarily, but more usually by direct extension from disease in an adjacent bone or joint.

Masses of *bone* may develop in bone or tendon, and these may be attached to bone, or not.

Extravasations of blood, due to partial or complete rupture of a muscle, may produce a swelling which may simulate a new growth closely. The congenital sterno-mastoid tumour affords a very good example of a condition which is commonly mistaken for tumour.

Again, *myositis* resulting primarily from injury, or arising spontaneously, may form a swelling that may be mistaken for a tumour.

The contraction of the two portions of a *ruptured muscle* or the *hernia of a muscle* through an aperture in the deep fascia produces conditions which simulate tumours.

Trichinosis, which attacks muscles, is described elsewhere (p. 327, Vol. I.). It is not likely to be mistaken for tumour.

Teno-synovitis.—*Acute teno-synovitis* varies somewhat in character with the factors determining its development.

In some cases the inflammation of the serous lining of the sheath is accompanied by no fluid effusion, but by the formation of a fibrinous exudation which lines the sheath and covers the

tendon. When such is the case, any voluntary movement of the muscle affected is accompanied by great pain and by a creaky sensation, which can be felt by the hand placed on the part.

This dry condition may go on to the effusion of a serous fluid, and in some cases much plastic material is thrown out, and adhesions may form between the tendon and sheath.

These several variations or stages are sometimes described as dry, serous, and plastic.

Acute suppuration may also result, and will be described under a separate heading.

Acute synovitis may be produced by excessive use of the affected tendons, either in sports, in prolonged exercise, or in certain occupations, as those of gymnasts, pianists, etc.

Teno-synovitis may develop from gonorrhœa, rheumatism, scarlet fever, or during the secondary stage of syphilis.

It occurs most commonly in the hand, in connection with the extensor tendons, and in the feet about the tendons of the peronei and the long extensors of the toes. Besides the pain experienced on movement or on pressure on the part, there may be a variable amount of inflammation of the superjacent structures, indicated by inflammatory œdema and redness.

Treatment.—When produced by violence, rest, counter-irritating applications, mercurial ointments, and massage are useful. When produced by syphilis, rheumatism, etc., these conditions must be met by appropriate drugs as far as possible.

Suppurative teno-synovitis may be produced in one of three ways:—

- (1) By direct septic infection of the synovial sheath by a wound.
- (2) By a secondary infection from adjacent structures. This is seen frequently in the finger where an infective cellulitis spreads from the connective tissue about the vaginal sheath into its interior. An infective process in a phalanx or joint may extend in a similar manner.
- (3) In rare cases by a secondary process, as in pyæmia, scarlet fever, typhoid fever, etc.

When the infective process starts in the sheath, as in varieties 1 and 3, the symptoms are fairly definite; but in cases included under form 2 it is sometimes very difficult in the early stage to determine whether the sheath is infected or not.

There can be but little doubt that infection of the thecal sheath results not uncommonly from the knife of the surgeon, in that in incising too freely an area of infective cellulitis about the end of the finger, he lays open, and consequently infects, the sheath of the tendons, so producing the condition which his operative interference is intended to avoid.

Symptoms.—Suppurative teno-synovitis is indicated by pain, swelling of the surrounding connective tissues and skin, with œdema, and, later, tense brawny induration, which subsequently becomes boggy, the skin being undermined by branching abscesses.

This sequence is due to the infection of the structures about the sheath by the septic process going on in its interior. If not interfered with, these abscesses burst externally. The sheath itself soon yields, and discharges pus freely. After a time the tendons may necrose, and the dead tissues may escape through the discharging sinuses.

In many cases the infective process extends to the sheath of the flexor tendons beneath the annular ligament, and later to the connective tissue planes in the fore-arm and arm. The process may also extend rapidly in the subcutaneous connective tissue. The virulence of the infective process depends largely on the particular variety of organism introduced, upon the quantity inoculated, and upon the health and vigour of the recipient.

Treatment.—There is little doubt but that the best treatment for a spreading infective cellulitis is free incision, care being taken not to open and infect sheaths not already infected. Should there be evidence of suppuration within a tendon sheath, it must be opened at once and freely. As rigidity of a finger almost always follows upon a suppurative inflammation of its vaginal sheath, it is often wise to amputate the finger without delay.

Suppuration about the tendons in a sheath may be very chronic, and the adjacent bones and joints may be infected and destroyed. Should it be desirous to retain the finger, even though stiff, the sheath may be slit up along its length, the tendons excised, and the cavity so left plugged with gauze containing sulphur or iodoform, till the septic process has subsided.

Chronic teno-synovitis.—Many of the conditions which were regarded as examples of chronic teno-synovitis have recently been shown to be tuberculous.

The *symptoms* and causation of this condition are very similar to those present in the several acute varieties, except that there is little or no pain, the patient complaining only of weakness or heaviness in the affected part.

In the dry form, besides a thickening of the synovial membrane, some loose masses may be present in the interior of the sheath.

In the serous variety, the sheath, which is thickened, and often irregularly dilated, contains a liquid which looks like concentrated synovial fluid. This exists in different degrees of tension, the tumour being sometimes tense and elastic, and sometimes fluctuating freely. When the hands are affected the fingers are kept more or less flexed in the palm, the patient being unable to extend them completely.

These conditions may be mistaken for tuberculous teno-synovitis, for a lipoma of the tendon sheath, or for a ganglion.

Treatment.—Prolonged rest, with counter-irritation, mechanical support with pressure, the avoidance of frequent or violent movements of the affected part, aspiration followed or not by the injection of iodine, incision and drainage, and complete excision of a localised collection, are each of service in suitable cases.

Tuberculous teno-synovitis.—The best and most simple classification of this condition is that adopted by Duplay and Reclus. They describe two forms: the first associated with the formation of melon-seed or rice-shaped bodies, and the second a fungating synovitis.

(1) *Tuberculous teno-synovitis, hygroma or hydrops, with melon-seed or rice-shaped bodies.*—Recent research has served to differentiate from true chronic serous teno-synovitis such forms of teno-synovitis as are associated with the presence of rice-shaped or melon-seed bodies, as they are often called in England. These have been shown to be tuberculous in origin by the presence of tubercle bacilli in the cyst wall, and by the production of tuberculosis by inoculation experiments with the melon-seed bodies. The term compound ganglion was till recently used to cover these cases; but whether it comprehends others besides or not is very doubtful.

In most cases the structure of the lining of the sheath is very characteristic. The naked-eye appearance of the interior varies a good deal. Sometimes it is smooth; at other times irregular and covered with a membrane, separating in places; while occasionally small melon-seed masses may hang in more or less abundance in a pedunculated manner from it. It consists of an outer, more or less firm, fibrous wall, a middle formed of granulation tissue, and an inner layer of a fibrous-looking material, containing a few nuclei scattered through its substance. In the outer and middle walls characteristic tuberculous nodules with bacilli can be seen.

The fluid contents vary in quantity and in character. It is usually a clear transparent fluid, very thin, and of a specific gravity but little above that of water.

The melon-seed or rice-like bodies exist also in a variable number, differing a good deal in size and form, the average size being about a quarter of an inch. They are smooth and almost polished in appearance, and of a whitish colour. They vary somewhat in structure, being sometimes homogeneous and structureless, and resembling fibrin; or they may be made up of concentric laminæ, between which there may be some finely granular material; or they may be formed of groups of fatty cells and masses of granular or reticulated fibrin, arranged in an areolar structure, as described and figured by Nicaise, Poulet, and Vaillard;* or, again, the rice-like body may consist entirely of a cellular structure arranged in a laminated manner in its periphery.

Tubercle bacilli have been found, but very occasionally, in these bodies. Rarely, distinct miliary tubercles have been recognised in them.

Though bacilli may apparently not be present in the rice-shaped bodies, inoculation with them generally results in the development of a tuberculous process.

They are now usually supposed to be derived from the innermost

* *Revue de Chir.*, 1885.

layer of the sheath, which is partly separated, folded, or rolled up by the friction and play exerted by the tendons upon it.

Symptoms.—The onset of this condition is usually very gradual. It is often ascribed to some sudden strain, as in lifting a very heavy weight; at other times it would appear to depend on habitually excessive exercise, as involved by the pursuit of some laborious occupation, as wringing clothes. It affects women much more commonly than men; the feeble and delicate more often than the robust and healthy; and those with tuberculous antecedents, or with tuberculous manifestations elsewhere, rather than those in whom there is no history of such liabilities or manifestations.

The tendon sheaths about the wrist are much more commonly affected than any other. The symptoms complained of are a variable amount of loss of power, more or less pain, and the presence of some deformity. The swelling or tumour fluctuates freely, and in many cases the existence of the melon-seed or rice-shaped bodies can be determined by the peculiar feeling of ill-defined grating or crepitation which they yield to the finger as they slip from beneath it when pressed on. It is quite characteristic and unmistakable, and is apparently frictional, being due to their movement upon the interior of the sheath and upon each other. If the swelling is considerable, the freedom of movement of the affected parts is limited proportionately (Fig. 473).

They are very chronic. In some cases the superficial structures may become involved, and a fistulous opening may result. After the cavity has become infected the tuberculous process may take on a more fungating character.

Diagnosis.—As a rule, this condition is readily recognised by the presence of fluctuation, and by the peculiar feeling given to the finger by the rice-shaped bodies. It is sometimes difficult without puncturing to differentiate between such a disease of the tendon sheath and true ganglion when the latter occupies an unusual position.

Occasionally a lipoma in the palm of the hand will simulate a tuberculous teno-synovitis of the sheath of the flexor tendons, and sometimes a chronic abscess or gumma may present symptoms very suggestive of it.

Treatment.—The best mode of treatment is to slit up the wall of the sac along its whole length, evacuating the fluid contents and melon-seed bodies, scraping carefully and thoroughly the inner aspect of the wall, and soaking it for a little with strong carbolic lotion, or with chloride of zinc solution. Then, after bringing the edges of the sheath together with silk sutures, close the skin incision also, and apply a permanent dressing.

Other methods of treatment are also made with greater or less success—such as aspiration, or aspiration followed by the injection of tincture of iodine, glycerine and iodoform, and liquid carbolic acid. The incision and drainage, with or without division of the annular ligament in the variety affecting the flexor tendons at the wrist, was

fluctuate. The muscle is more or less fixed, and its extension is painful or impossible. The patient experiences an aching pain in the part. The muscles of the limbs are those most frequently affected.

In its early stage complete recovery takes place under treatment, but in the cicatricial stage no benefit is obtained.

The *gumma* forms a hard oval painless mass in the substance of the muscle, presenting an outline that is usually well defined. They are rarely single. Not uncommonly these tumours are multiple within quite a small area. Eight or ten may occasionally be felt in the substance of the tongue. On section, they are clearly circumscribed, greyish-yellow or whitish in colour, and gelatinous, caseous, or fibrous in structure. Gummata in muscles, as elsewhere, if untreated, are liable to undergo necrotic changes, and in old people the ragged deeply undermined ulcers that result may assume in the mouth or pharynx an epitheliomatous character. Less frequently, cicatricial contraction results.

In either case the muscular mechanism, which is the seat of the sclerosing myositis or of the *gumma*, whether it breaks down or cicatrises, is depreciated to a variable extent by it.

The symptoms presented are those of a tumour, which is fixed when the muscle is contracted. Pain is rarely present, but when it exists it is nocturnal, or increased at night.

The diagnosis between *gumma* and tumours of the connective tissue, or epithelial type, is determined very rapidly by treatment.

The result of treatment depends obviously to a large extent on the stage at which drugs are commenced.

Contraction of muscles and fasciæ.—Muscles, tendons, and fasciæ which have been permitted to remain relaxed and unexposed to tension for a considerable period of time can often no longer be extended to their normal length.

This occurs occasionally when a part, such as the fore-arm and hand, has been fixed immovably on a splint for an excessive period of time, because of a fracture of one or both bones of the fore-arm, the fingers being retained in a position of flexion. On attempting to extend the fingers and wrist in such a case, the resistance which is offered by the muscles and tendons is in many cases so great as to permit of no movement whatever.

Treatment.—In some cases much benefit may be derived from manipulation, extension, and the use of splints, by which traction or pressure may be applied in order to overcome the contraction. In severe conditions, the subcutaneous section of tendons may be of some service, but even from this but little benefit may be derived. It is advisable not to divide all the tendons at the same level, but to sever them separately, and at a distance the one from the other. If the fascia obviously opposes extension, it should be divided also; and the same applies to ligaments, which readily shorten and become fixed in the contracted position.

A like condition arises where a joint is, during some long

illness, or on account of some painful condition, retained for a long period of time in a position of flexion.

In such a case traction, assisted by massage, manipulation, and the subcutaneous section of muscular, tendinous, fascial, or other structures opposing extension, may remove the disability more or less completely.

In many cases treatment, however thorough, is of but little use in restoring the parts to their original freedom of movement.

Deformities resulting from atrophic changes in muscles, whether due to disease of the cord or to damage to or disease of the nerves, hardly come under this heading, and will be referred to elsewhere (page 58).

Atrophy of muscle.—This condition may result from a lesion of the anterior cornua of the cord, or of the nerves supplying the affected muscles. In certain cases it may be due to some idiopathic condition of the muscle itself.

The following table, with remarks on the reaction of degeneration, from Dr. Frederick Taylor's work on Medicine, serves briefly to elucidate the causation of the several conditions:—

Varieties.—*Myelopathic: Diseases of anterior cornua.*

(a) Acute: Atrophic spinal paralysis, or acute poliomyelitis.

(b) Chronic { Protopathic: Progressive muscular atrophy.
Deuteropathic: Amyotrophic lateral sclerosis.
Hypertrophic cervical meningitis.
Atrophy following locomotor ataxy.
Atrophy following disseminated sclerosis.

By "protopathic" is understood disease commencing in the anterior cornua of the spinal cord; by "deuteropathic" disease of the cornua brought about by extension from changes in other parts as the lateral columns, posterior columns, or meninges.

Neuropathic: Diseases of nerves.

(a) Acute: Injury.

(b) Sub-acute: Neuritis.

(c) Chronic: Compression, Hypertrophic cervical meningitis.

Myopathic: Diseases of muscle.

Pseudo-hypertrophic paralysis, Idiopathic muscular atrophy.

The reaction of degeneration, expressed for convenience as R.D., affords the most important clinical evidence of the existence of a disease affecting the nerve nuclei, nerve trunk, or muscles.

Complete R.D. consists of loss of excitability in the nerve to both faradic and galvanic currents; loss of excitability in the muscle to the faradic current, increased excitability in the muscle to the galvanic current, with qualitative or polar changes and sluggish contractions.

In incomplete forms of R.D. the reaction of the muscle to galvanism is as just described, but the excitability of the muscle

to faradism, and of the nerves to either, is not lost but only lowered.

A mixed variety is also described, in which the muscle contractions to galvanism are neither very sluggish nor very prompt. It occurs where degenerated fibres of muscle or of nerve lie side by side with others that are healthy.

Anatomical changes.—The anatomical changes presented by the muscles in the various diseases referred to vary considerably; for instance, in progressive muscular atrophy the muscles are pale and small, the fibrillæ are found more or less degenerated, being diminished in size or with striation, which is indistinct or replaced by fatty granules. Sometimes there is longitudinal striation, and sometimes waxy or vitreous degeneration.* The connective tissue of the muscle is increased in quantity.

In pseudo-hypertrophic paralysis the muscles are large, and look like masses of fat. The muscle-fibres are thinly scattered about in fat and fibrous tissue.

Atrophy from disuse.—Besides the atrophic changes just described, a muscle may waste and undergo a considerable amount of fatty change from want of use. This is partly the cause of the wasting in muscles about a chronically diseased joint. Again it may occur in muscles which have ceased to perform any function, as, for instance, the muscles which act upon a joint that has become fixed by disease or operation.

In fatty degeneration the structure of the fibre is altered by the fatty granules; and in the intervals between the fibres fat cells are developed in considerable quantity, the muscle cell finally disappearing.

Tumours of muscles and tendons.—Muscles may be affected by primary growths, by direct extension from a neighbouring growth, and by secondary or metastatic tumour deposits.

Carcinoma.—The various forms of carcinoma may involve and destroy any muscular structure with which they may come into relationship. Familiar examples of this are afforded by the extension of cancerous growths in the breast to the pectoral and intercostal muscles; and in the cases of epithelioma of the lip or tongue by the implication and destruction of the muscles of the face and of the tongue by the spreading growth.

Again, a metastatic or secondary carcinomatous focus may form in a muscle at a considerable distance from the primary growth.

Carcinoma never develops primarily in a muscle.

Sarcoma.—Primary sarcoma of muscle is comparatively rare. Many of the sarcomata invade muscle by direct extension or by the formation of secondary foci.

Sarcomata affect tendons and tendon sheaths both in their fibrous and synovial structures. When the fibrous or synovial walls of the

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tendon. When such is the case, any voluntary movement of the muscle affected is accompanied by great pain and by a creaky sensation, which can be felt by the hand placed on the part.

This dry condition may go on to the effusion of a serous fluid, and in some cases much plastic material is thrown out, and adhesions may form between the tendon and sheath.

These several variations or stages are sometimes described as dry, serous, and plastic.

Acute suppuration may also result, and will be described under a separate heading.

Acute synovitis may be produced by excessive use of the affected tendons, either in sports, in prolonged exercise, or in certain occupations, as those of gymnasts, pianists, etc.

Teno-synovitis may develop from gonorrhœa, rheumatism, scarlet fever, or during the secondary stage of syphilis.

It occurs most commonly in the hand, in connection with the extensor tendons, and in the feet about the tendons of the peronei and the long extensors of the toes. Besides the pain experienced on movement or on pressure on the part, there may be a variable amount of inflammation of the superjacent structures, indicated by inflammatory œdema and redness.

Treatment.—When produced by violence, rest, counter-irritating applications, mercurial ointments, and massage are useful. When produced by syphilis, rheumatism, etc., these conditions must be met by appropriate drugs as far as possible.

Suppurative teno-synovitis may be produced in one of three ways:—

(1) By direct septic infection of the synovial sheath by a wound.
(2) By a secondary infection from adjacent structures. This is seen frequently in the finger where an infective cellulitis spreads from the connective tissue about the vaginal sheath into its interior. An infective process in a phalanx or joint may extend in a similar manner.

(3) In rare cases by a secondary process, as in pyæmia, scarlet fever, typhoid fever, etc.

When the infective process starts in the sheath, as in varieties 1 and 3, the symptoms are fairly definite; but in cases included under form 2 it is sometimes very difficult in the early stage to determine whether the sheath is infected or not.

There can be but little doubt that infection of the thecal sheath results not uncommonly from the knife of the surgeon, in that in incising too freely an area of infective cellulitis about the end of the finger, he lays open, and consequently infects, the sheath of the tendons, so producing the condition which his operative interference is intended to avoid.

Symptoms.—Suppurative teno-synovitis is indicated by pain, swelling of the surrounding connective tissues and skin, with œdema, and, later, tense brawny induration, which subsequently becomes boggy, the skin being undermined by branching abscesses.

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In many cases the infective process extends to the sheath of the flexor tendons beneath the annular ligament, and later to the connective tissue planes in the fore-arm and arm. The process may also extend rapidly in the subcutaneous connective tissue. The virulence of the infective process depends largely on the particular variety of organism introduced, upon the quantity inoculated, and upon the health and vigour of the recipient.

Treatment.—There is little doubt but that the best treatment for a spreading infective cellulitis is free incision, care being taken not to open and infect sheaths not already infected. Should there be evidence of suppuration within a tendon sheath, it must be opened at once and freely. As rigidity of a finger almost always follows upon a suppurative inflammation of its vaginal sheath, it is often wise to amputate the finger without delay.

Suppuration about the tendons in a sheath may be very chronic, and the adjacent bones and joints may be infected and destroyed. Should it be desirous to retain the finger, even though stiff, the sheath may be slit up along its length, the tendons excised, and the cavity so left plugged with gauze containing sulphur or iodoform, till the septic process has subsided.

Chronic teno-synovitis.—Many of the conditions which were regarded as examples of chronic teno-synovitis have recently been shown to be tuberculous.

The *symptoms* and causation of this condition are very similar to those present in the several acute varieties, except that there is little or no pain, the patient complaining only of weakness or heaviness in the affected part.

In the dry form, besides a thickening of the synovial membrane, some loose masses may be present in the interior of the sheath.

In the serous variety, the sheath, which is thickened, and often irregularly dilated, contains a liquid which looks like concentrated synovial fluid. This exists in different degrees of tension, the tumour being sometimes tense and elastic, and sometimes fluctuating freely. When the hands are affected the fingers are kept more or less flexed in the palm, the patient being unable to extend them completely.

These conditions may be mistaken for tuberculous teno-synovitis, for a lipoma of the tendon sheath, or for a ganglion.

Treatment.—Prolonged rest, with counter-irritation, mechanical support with pressure, the avoidance of frequent or violent movements of the affected part, aspiration followed or not by the injection of iodine, incision and drainage, and complete excision of a localised collection, are each of service in suitable cases.

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(1) *Tuberculous teno-synovitis, hygroma or hydrops, with melon-seed or rice-shaped bodies.*—Recent research has served to differentiate from true chronic serous teno-synovitis such forms of teno-synovitis as are associated with the presence of rice-shaped or melon-seed bodies, as they are often called in England. These have been shown to be tuberculous in origin by the presence of tubercle bacilli in the cyst wall, and by the production of tuberculosis by inoculation experiments with the melon-seed bodies. The term compound ganglion was till recently used to cover these cases; but whether it comprehends others besides or not is very doubtful.

In most cases the structure of the lining of the sheath is very characteristic. The naked-eye appearance of the interior varies a good deal. Sometimes it is smooth; at other times irregular and covered with a membrane, separating in places; while occasionally small melon-seed masses may hang in more or less abundance in a pedunculated manner from it. It consists of an outer, more or less firm, fibrous wall, a middle formed of granulation tissue, and an inner layer of a fibrous-looking material, containing a few nuclei scattered through its substance. In the outer and middle walls characteristic tuberculous nodules with bacilli can be seen.

The fluid contents vary in quantity and in character. It is usually a clear transparent fluid, very thin, and of a specific gravity but little above that of water.

The melon-seed or rice-like bodies exist also in a variable number, differing a good deal in size and form, the average size being about a quarter of an inch. They are smooth and almost polished in appearance, and of a whitish colour. They vary somewhat in structure, being sometimes homogeneous and structureless, and resembling fibrin; or they may be made up of concentric laminae, between which there may be some finely granular material; or they may be formed of groups of fatty cells and masses of granular or reticulated fibrin, arranged in an areolar structure, as described and figured by Nicaise, Poulet, and Vaillard;* or, again, the rice-like body may consist entirely of a cellular structure arranged in a laminated manner in its periphery.

Tubercle bacilli have been found, but very occasionally, in these bodies. Rarely, distinct miliary tubercles have been recognised in them.

Though bacilli may apparently not be present in the rice-shaped bodies, inoculation with them generally results in the development of a tuberculous process.

They are now usually supposed to be derived from the innermost

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at one time often performed, and was frequently followed by good results.

(2) *Fungating teno-synovitis* is a tuberculous affection of the synovial membrane, covering the tendons and the interior of their sheaths. It behaves in much the same way as tuberculous conditions elsewhere. It may commence in the tendon sheath, or it may arise secondarily to disease of an adjacent bone or joint, or to tuberculous affection in the superjacent subcutaneous tissue.

It develops under conditions and circumstances very similar to those already described in the case of teno-synovitis with melon-seed bodies. The tendon sheaths affected are those in the hand and feet especially, and in the latter chiefly in the vicinity of the ankle joint.

It may be limited to a short length only of the lining membrane of a sheath, or it may extend along its whole length and to those adjacent to it. It may reach to the bones or joints in immediate relation with it, or it may destroy the sheath and superficial connective tissue, and discharge externally.

The structure of the diseased synovial membrane is typically tuberculous, and often shows giant-cells of the greatest size and perfection. It varies quite as much in structure and appearance as does the synovial membrane of a joint when affected by tubercle. The tendon may remain unaffected for a long period of time, and may glide through the pulpy tissue unchanged. Later, it also becomes covered with similar granulation tissue, which eats its way in between the bundles of fibrous tissue, breaking them up, and finally rendering the tendon functionless. The granulation tissue may escape from the sheath through a comparatively small aperture, and may form a large fungating mushroom-like mass beneath the skin.

The behaviour of the tendon sheaths when affected secondarily to disease in adjacent bone, joint, connective tissue, or tendon sheath differs in no important particular from the disease starting primarily in them.

Symptoms.—The tumour occupies the position of part or the whole of a tendon sheath. When limited, it can be readily mistaken for a fatty tumour, or for a sarcomatous tumour of the exterior of the tendon sheath, or for sarcoma or syphilitic disease of its interior.



Fig. 471.—Tuberculous Teno-synovitis.

Fig. 471 illustrates a case of primary tuberculosis of a portion of the synovial lining of the tendon sheath of the index finger. The growth presented no sign of caseation whatever; it contained a large number of giant-cells, and of epithelioid cells.

Fig. 472 represents a fungating tuberculous teno-synovitis in an old woman, affecting the palmar synovial sheaths with those of the thumb and fingers to a variable extent. In the case of the thumb,

two large mushroom-like masses covered the sheath. The sheath and superjacent skin of the little finger had been destroyed in places,



Fig. 472.—Tuberculous Teno-synovitis.

and a similar result has been brought about on the side of the index finger.

Treatment.—It reacts to the same remedies as tubercle does elsewhere; and if it does not yield to them, should be treated by as thorough removal as the anatomy of the affected parts will allow.

Ganglion.—A ganglion is a rounded, well-defined tumour, seldom reaching the size of a walnut, and usually much smaller, occurring most frequently about the radial side of the wrist, and especially on its dorsal aspect; it is also found in the palm of the hand, on the flexor aspect of the fingers, on the dorsal aspect of the foot, and

about the insertions of the hamstring muscles. These cysts occur most frequently in females and during the period of adolescence. Musicians, and such as are engaged in pursuits in which much strain is thrown habitually on the tendons about the wrist, are peculiarly liable to them.

Symptoms.—They are rounded or flattened tumours, sometimes soft and fluctuating, at other times so tensely distended as to simulate a solid tumour.

Pathology.—They consist of a fibrous cyst wall, with a more or less perfect endothelial lining, with contents which are characteristic in appearance, being jelly-like or colloid in consistence.

They but rarely communicate with the interior of adjacent joints or tendon sheaths, though almost invariably they are found to be intimately connected with the fibrous coverings of these structures, but more frequently and more closely with the joint capsule than with the tendon sheath. There is much difference of opinion as to the mode in which these tumours are developed. In his valuable article in the *American Journal of Medical Science*, Dr. Evans, of Chicago, states that the theories as to their origin may be considered under three headings :—

(a) As a tunicary hernia of a joint capsule or tendon sheath. The objections to this view are that ganglia do not occur at those parts of the sheath which are subject to sacculation under pressure, and that there is an absence of previous distension of tendon sheaths, the peculiar character of the contents, and the absence of any communication with tendon and sheath cavities.

(b) Gosselin found existing normally in joints pouch-like crypts or glands; and Michon found the same structures in tendon sheaths. It is from these that ganglia are supposed to originate.

(c) The ganglia are new formations, having no connection with the tendon sheaths or joints (Teichmann and Knorr).

Treatment.—The most satisfactory operative procedure consists in excising the tumour, which, if satisfactorily performed, is invariably successful in preventing recurrence. Rupture of the cyst wall by a sharp blow or by firm pressure or subcutaneous section of the wall is occasionally followed by the permanent disappearance of the tumour; but, as a rule, such treatment is only palliative.

Difficulty may occasionally occur in differentiating ganglia from solid tumours of tendon sheaths, such as fibroma, lipoma, sarcoma, tuberculous nodule, and gumma; also from bursæ in the neighbourhood of joints.

Compound or diffuse palmar ganglion.—This condition is very often an example of that form of tuberculous teno-synovitis associated with melon-seed bodies (page 21). There exists in the palm of the hand and in the adjacent portion of the fore-arm a swelling, which is subdivided into two by the anterior annular ligament, the portion above the ligament being usually much more prominent than that in the palm. It fluctuates freely; and on manipulation, it yields to the finger the peculiar crepitating sensation

already referred to (page 22). Occasionally the swelling is continued along the vaginal sheath of the flexor longus pollicis, and less frequently along the sheath of the little finger. Rarely, apparently separate enlargements are seen in the palm or in the sheaths of the other digits.

The patient is unable to flex the hand beyond a certain degree, and complete extension is also impossible.

Fig. 473 represents this condition affecting the extensor tendons in the hand of a woman aged thirty-nine. Her mother and two of her children had died of consumption. When nineteen years old she suffered from tuberculous disease of the knee joint, with supuration, and later from tuberculous disease of the hip, from both of which she recovered completely. About six years ago she sprained her wrist when turning a mangle, and very soon afterwards a lump formed on the back of the wrist, and this increased in size, without much pain, till it reached the bulk indicated by the figure. The swelling



Fig. 473.—Diffuse Ganglion of Extensor Tendons.

fluctuated freely, and gave on careful palpation a crepitating sensation. The depression below its centre was caused by the annular ligament. It was

laid freely open by Mr. Clement Lucas; the numerous melon-seed bodies, and the fluid contents, were removed; the wall of the cavity was carefully scraped and soaked with strong carbolic lotion, and the divided structures were then accurately sutured. Union took place under a single dressing.

The *treatment* of this affection is roughly indicated by this case, since there is little doubt but that the disease is usually tuberculous.

Syphilitic affection of tendon sheaths.—During the *secondary stage* the tendon sheaths may be affected by a painless distension, which is often symmetrical. This is a very rare affection, and has been observed mainly in the sheaths of the extensor tendons in the hand and foot. It develops suddenly, fluctuates freely, is not tender, nor is the skin over it inflamed. But little limitation of movement of the affected parts results from this condition.

Like the other syphilitic manifestations with which it is usually associated, it yields at once to remedies. This association, and the result of treatment, with the freedom from pain and tenderness, and the absence of gout or rheumatism, serve to render the diagnosis certain.

Tertiary syphilitic affections of tendons usually appear about five years after contagion, but they may not do so for very many years. The affection depends upon the development of gummata.

Besides the tendons, the aponeurotic expansions of muscles may also be affected. The aponeuroses of the vasti, the tendo Achillis, and the flexor tendons of the fingers are those most often attacked.

Fig. 474 illustrates such an affection of the tendo Achillis.

The gumma may be present as a greyish-yellow elastic mass on the surface of the tendon; or the latter may be broken and invaded by the syphilitic material, which also involves and destroys superficial or adjacent structures.

Again, the tendons, as well as the tendon sheaths, may be involved by extension from syphilitic disease of the joints with which they are in immediate relation.

To differentiate these conditions from those due to tubercle is often very difficult indeed, and in some cases one is obliged clinically to rely on the rate and degree of alteration resulting from the administration of anti-syphilitic remedies. The age and physical condition of the patient, and the presence or history of any other syphilitic manifestation, may help to distinguish these conditions. Should the gummatous material have softened, and ulceration of the superjacent skin with the formation of ragged undermined sores, with "wash-leather" sloughs have come about, a mistake can hardly be made.

At the same time, if these conditions are untreated, they may continue for months or years without much destruction of parts ensuing.

It must be hard or impossible in many cases to distinguish between a primary gummatous affection of the tendon and a similar change commencing in the synovial lining of the tendon sheath. It happens occasionally that tertiary syphilitic affections of the tendons of the fingers are mistaken for whitlow, gout, rheumatoid arthritis, and sarcoma of the tendon sheath.

It is well to remember that these tertiary manifestations of syphilis, especially when they have become infective by destruction



Fig. 474.—Syphilitic Disease (Gumma) of the Tendo Achillis. (Duplay and Reclus.)

of the skin, may take some considerable time in yielding to anti-syphilitic remedies.

Rheumatic nodules.—These are hard, subcutaneous, more or less rounded masses, consisting of round and spindle cells. They

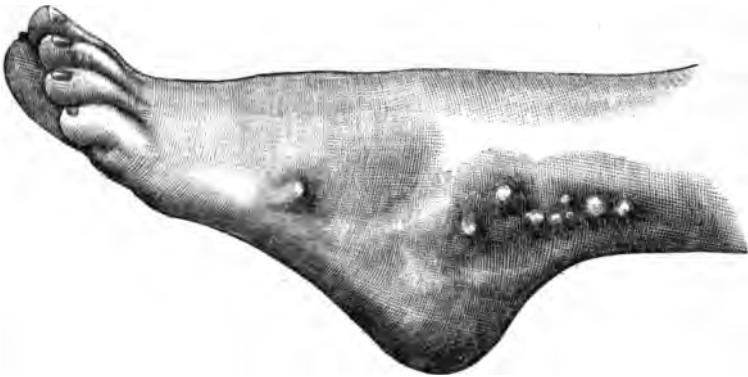


Fig. 475.—Rheumatic Nodules. (Dr. Newton Pitt's case.)

form on fasciæ and tendons, and vary in size from small nodules which can be just felt to masses as large as a big pea.

These are most numerous about the fingers, hands, and wrist; but are also not uncommonly observed about the elbows, knees, spinous processes of the vertebræ, and scapulæ.

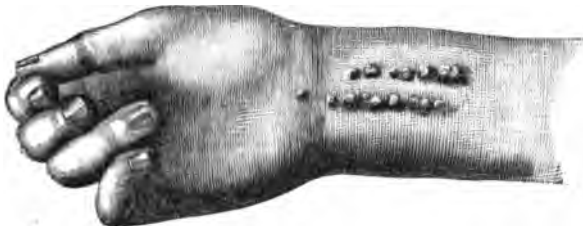


Fig. 476.—Rheumatic Nodules. (Dr. Newton Pitt's case.)

They are not often painful or tender. They may develop during or after an acute attack of rheumatism; or they may arise quite independently. Their presence is always indicative of that of rheumatism.

They often form very rapidly, and last usually for several weeks or months.

They are more common in children than in adults.

They have been observed in association with severe and chronic rheumatic endocarditis.

Figs. 475 and 476 represents these nodular masses which developed in a patient of Dr. Newton Pitt's.

III. CONTRACTION OF FASCIÆ.

Dupuytren's contraction of the palmar fascia.

Pathology.—This condition consists in what is apparently a cicatricial contraction and hypertrophy of the palmar fascia, of the superjacent skin, and sometimes also of the vaginal sheaths and palmaris longus tendon.

In undergoing this change the fascia first becomes adherent to the skin in the position of the natural grooves, the skin changing its character and blending inseparably with the subjacent fascia. The intermediate convexities of the skin in the palm are also exaggerated, and the tissues of the corium are rendered abnormally dense. Occasionally the vaginal sheath becomes involved separately or in continuity with the fascial processes, and a sharp bridle-like ridge results.

Fig. 477 represents a case of Dupuytren's contraction of the palmar fascia of many years' standing.

As time goes on the articulations of the phalanges and metacarpal bones alter their form, in consequence of the prolonged assumption of the position of flexion; and that portion of the articular cartilage which no longer performs its articular function undergoes degenerative changes. The anterior ligaments of the joints also become permanently shortened, and in very advanced cases afford with the shortened muscle and tendons an absolute bar to the restitution of the finger in the straightened position.

These changes are described fully in a paper in the Guy's Hospital Reports, vol. xliii.

Symptoms.—The disease is almost entirely limited to the male sex, and rarely appears under the age of twenty-five years. It commences in the little finger, which becomes flexed upon the palm, and gradually extends outwards to the other fingers, and finally to the thumb.

The amount of flexion of the fingers may become so extreme as to render the hand useless. The disease is painless in its progress.

Causation.—The factors that determine the development of the deformity are often very obscure. When it occurs at an early period of life, it is probably gouty or rheumatic in origin. It is frequently hereditary. It would seem in some cases to be started by a wound of the palm, and in other cases by the habitual pressure of some instrument or support.



Fig. 477. — Dupuytren's Contraction.

Frequently, no cause for its development can be found. It seems to occur with equal frequency among the rich and poor; but the tendency to its development increases with age.

Treatment.—The form of treatment varies largely with the degree, character, and duration of the condition.

In slight cases the frequent use of manipulation and friction, with the aid of a suitable splint at night time, will serve to remove or prevent the return of the deformity. It is well to warn the patient that whatever means are used to straighten the fingers, they are liable subsequently to return to their flexed position, unless this tendency be opposed by constant attention.

In more advanced cases multiple subcutaneous sections of the tense processes of fascia, with the liberation as far as possible by the same means of the superjacent skin, where it is blended with the fascia in the natural furrows of the palm, will permit of the fingers being brought into a position of more or less complete extension. A splint should be applied, and the position of the fingers improved daily. Later, when the wounds have healed, manipulation and splinting at night-time will be of much service.

In other cases, again, the open method is more useful. Dupuytren used to perform this operation by cutting transversely across the tense skin and subjacent fascia. The objections to this treatment may be largely obviated by using an abundant skin graft, when it forms a valuable adjunct to the method of multiple subcutaneous section.

Goyrand, by means of a longitudinal incision, exposed the tense bands, and then divided them transversely; and Hardie modified this method by removing portions of fascia between the transverse sections.

A more or less complete excision of the contracted fascia and its processes, together with a liberal use of skin grafts, sometimes gives very good results.

In long-standing and severe cases these measures, however thoroughly carried out, and even when combined with section of the tense tendons and anterior ligaments of the joints, may be of no use owing to the extensive bony, ligamentous, and other changes.

Diagnosis.—Dupuytren's contraction may be simulated by the contraction of the fingers resulting from the prolonged use of splints, the flexor muscles having been retained for an excessive period in a position of flexion.

Again, a wound of the palm or fingers, or the condition which follows a septic teno-synovitis in the palm, may produce a deformity which somewhat resembles it.

The position of extreme flexion and adduction of feeble old age, and the deformities of the hand in certain paralyses, may also be mistaken for it. A careful examination of the part will, however, serve to differentiate it from these conditions.

Contraction of the plantar fascia.—This does not seem to develop in a manner similar to that occurring in the hand. This

fascia is, however, frequently found to be abnormally short in deformities, both congenital and acquired. In marked cases of talipes varus it is necessary to divide this structure freely in order to permit of the foot being placed in a position of abduction.

In "pes cavus," "hollow," or "clawed foot," the plantar fascia stands out rigidly and firmly, and offers a large proportion of the resistance which is experienced when an attempt is made to flex the foot. By some surgeons this contraction of the plantar fascia has been, among many others, regarded as the primary cause of the deformity. The shortening of the fascia is, however, only an associated result, as has been very clearly demonstrated by Mr. Parkin.* From a consideration of it, it is shown that in pes cavus it is rarely necessary or advisable to divide the contracted fascia.

The same apparent contraction of the plantar fascia takes place in many paralyzes and deformities, and it is consequent upon alterations in the relative positions of the tarsal and metatarsal bones.

IV. AFFECTIONS OF BURSÆ.

Chronic enlargement of bursæ connected with joints or tendons.—It is usually the custom to group bursæ of all kinds under one heading, but this is obviously incorrect.

For instance, the bursæ in communication with joints or between bones and tendons, or between tendons, or prolonged from a joint cavity around a tendon, may be distended for a long period of time without showing any tendency to undergo such change as results from the deposit of fibrin upon the interior of the sac.

When a bursa which communicates with the interior of a joint is chronically enlarged, its distension is usually due to some alteration in the structure of the joint with which it communicates, and not to any primary morbid condition in the bursa itself. This may be an excessive use of the joints, producing an abnormally large quantity of synovial fluid, or it may result from synovitis set up by damage to a fibro-cartilage, or from a loose body, or from one of the varieties of osteo-arthritis—usually the mechanical or traumatic. This last variety was fully described by Mr. Morrant Baker.

Enlargement of the semi-membranosus bursa.—A good example of the condition just described is afforded by an enlargement of the bursa between the semi-membranosus and inner head of the gastrocnemius, which I have endeavoured to represent in Fig. 478. When the knee joint is extended, a rounded, well-defined tense swelling is seen to occupy the lower part of the popliteal space, and to be slightly more prominent in its inner than in its outer part. It fluctuates distinctly. When the knee joint is flexed the tension in the bursal cavity is diminished, and the tumour becomes much less conspicuous, owing partly to some of the fluid contents

* Transactions of the Medico-Chirurgical Society, vol. lxxiv.

passing into the joint, and partly to the loss of the pressure exerted by the muscles and fasciæ.

Diagnosis.—Some doubt may arise in the surgeon's mind as to the character of the tumour. For instance, such a swelling may be mistaken for an aneurysm, an abscess, an enlarged gland, or a solid tumour.

It is distinguished from an aneurysm by the fact that if compressed while the circulation through the femoral artery is controlled, no change takes place in its bulk. It does not possess the same distinct expansile character, the impulse being simply transmitted. Any limit that may be present is ill-defined and indistinct. In many cases, when the cyst is not very large, it can be displaced and separated from the artery.

Aspiration with a hypodermic syringe at once determines the character of the tumour in any doubtful case.

From an abscess the enlarged bursa is distinguished by the long history and the absence of any signs of inflammation, such as great pain, inability to flex or extend the knee joint completely, local tenderness, and ill-defined brawny induration, etc. The abscesses most commonly found in this situation are glandular or due to necrosis of bone—usually of the portion of the femur forming the floor of the popliteal space.

Treatment.—When such a condition results from excessive use, as from football, etc., a rest from violent exercise, assisted perhaps by a little local pressure, may bring about the diminution or disappearance of the tumour. Though these tumours are by no means uncommon, it is but very rarely that they cause sufficient pain or discomfort to make the patient desire that they should be treated by more radical measures.

Fig. 478.—Chronic Enlargement of the Bursa between the semi-membranosus and the inner head of the gastrocnemius.



Aspiration, followed by blistering and rest, is frequently made use of with more or less advantage. Also after aspirating, injections of iodine and carbolic acid lotion are occasionally introduced. Obviously, the most certain method is the careful removal of the entire tumour.

Enlargement of other bursæ connected with joints or tendons.—The *sub-deltoid bursa*, which occasionally establishes a communication with the shoulder joint, may become enlarged, and form a definite rounded tumour which may protrude forwards between the deltoid and pectoralis major.

The bursa between the *gluteus maximus* and *great trochanter*,

that between the tendon of the *biceps* and the long external lateral ligament of the knee joint, the bursa that occasionally persists beneath the *quadriceps* (Fig. 479), and that beneath the *psoas*, may all become chronically enlarged. In almost all these there is little tendency to the deposition of fibrinous material upon the interior of the sac wall.

The treatment of these bursæ is to be conducted upon the same lines as are indicated above in dealing with the treatment of the semi-membranosus bursa.

Chronic enlargement of bursa which are not connected with joints.—Such bursæ, when chronically inflamed, have, unlike the bursæ above described, their walls much thickened by the deposition of layers of fibrin in their interior, so that in some cases all evidence of the original cavity may disappear. Examples are afforded by the bursa patellæ, the olecranon bursa, the bursa over the tuber ischii, the bursa between the ligamentum patellæ and tubercle of the tibia, and many others (Fig. 480).

A bursa may be developed in the connective tissue over any prominent bony part when it is exposed habitually to abnormal pressure. Such are seen in cases of talipes varus of old standing, in labourers who carry loads on the back, and in other similar conditions. In all such cases the enlarged bursa acts as a water-pillow and serves to save the skin from compression such as it could not bear without undergoing inflammatory change.

When the bursæ become enlarged, they are troublesome, partly on account of their bulk, and partly because they become painful and inflamed when pressed on. In some cases ulceration of the superjacent skin may result.

Enlargement of the bursa patellæ.

—Perhaps the bursa which most commonly presents the conditions above described is the bursa patellæ. This, when chronically enlarged, is spoken of as "*housemaid's knee*." If one kneels with the body erect, the weight of the body is transmitted to the ground through the tubercle of the tibia, but when the body is supported on the knees and left hand, as in scrubbing floors, the lower half of the patella, and the adjacent portion of the ligamentum patellæ are exposed to the greatest pressure. This is greater on the right than on the left side. As a consequence, the bursa patellæ, which corresponds in its position to the points of



Fig. 479.—Distended Condition of the Bursa beneath the subcrureus, which in this case had not communicated with the general synovial cavity of the knee joint.

greatest pressure in this last posture, becomes enlarged. If the process of enlargement be a chronic one, the wall of the sac is gradually thickened by the deposit of layers of a fibrinous material upon its interior, the oldest layers gradually organising. After a time the remaining cavity may itself become obliterated, and a solid tumour result.

In some occupations where the workman is, in kneeling, obliged to occupy various attitudes, the bursa may cover the whole of the patella, and may extend downwards below the tibial tubercle. This extensive development is seen occasionally in plumbers.

If neglected, pressure may lead to ulceration of the skin over the tumour, which may itself be opened and infected, a discharging foul sinus and cavity resulting.

Enlargement of other bursæ which are not connected with joints.—The bursa over the olecranon may be enlarged. The

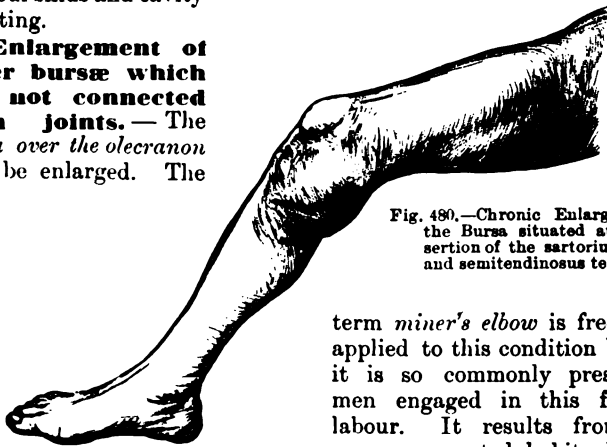


Fig. 480.—Chronic Enlargement of the Bursa situated at the insertion of the sartorius, gracilis and semitendinosus tendons.

term *miner's elbow* is frequently applied to this condition because it is so commonly present in men engaged in this form of labour. It results from any pressure exerted habitually and intermittently upon the hinder

surface of the olecranon. The changes which ensue in this bursa do not differ from those described in the bursa patellæ.

The bursa over the *tuber ischii* is enlarged in a similar manner in weavers and in those engaged in occupations of a very sedentary type.

In the tailor the pressure exerted on the *external malleoli* in the particular attitude assumed results in the development of bursal tumours over these bony prominences. These form the "tailor's bursæ."

There are three bursæ in relation with the hyoid bone and thyroid cartilage, which may become chronically enlarged. They are: (1) The *anti-thyroid bursa*, which covers the *pomum Adami*; (2) the *infra-hyoid bursa*, which extends from the edge of the thyroid cartilage over the thyro-hyoid ligament up to its attachment to the hyoid bone; and (3) the *supra-hyoid bursa*, which lies in immediate relation with the hyoid bone between the genio-hyoid and genio-hyo-glossus muscles. The infra-hyoid bursa is most often affected.

In such as are employed in carrying loads on the shoulder, the *acromial bursa*—a subcutaneous bursa, which covers the upper surface of the acromion—is occasionally enlarged, and may form a tumour as large as a tennis-ball.

The "*carpet-layer's bursa*" is an enlargement of a bursa which is present in normal conditions over the inner condyle of the femur. It arises from the use of the stretcher, an instrument which is worked by repeatedly knocking the knee against it.

In many of these bursæ, instead of the exterior of the wall being thickened by the deposit of fibrin, portions of the wall may become detached and form loose bodies, or pedunculated masses of fibrin may remain attached to the thickened wall.

Occasionally an already enlarged bursa becomes acutely distended, owing to the discharge of blood into its cavity. The blood may become decolorised and organised, and form loose bodies.

Treatment of enlarged bursæ which are not connected with joints.—The several measures which can be adopted depend chiefly on the fluidity of contents, the thickness of the wall, and the presence of pedunculated or free masses in the cavity.

Sometimes under the influence of prolonged rest and counter-irritation a large fluid bursa may subside.

Aspiration, associated with pressure, is useful under the same circumstances. It is used in two ways—either by completely emptying the sac of its contents at one sitting or by several tapplings, a proportion only being removed on each occasion.

It is obvious that if movable bodies are present these methods are not permanently curative. In such cases the cavity must be incised along its length and scraped, or the bursa must be excised.

In old-standing thin-walled bursæ a cure may result from a rupture of the sac wall, and the discharge of the fluid contents into the surrounding connective tissue. To do this, the tumour is first rendered tense by placing the limb in a suitable position. The same result may be brought about by an extensive subcutaneous section of the wall of the sac.

When such methods have failed, or when the wall of the sac is thickened, excision yields the most satisfactory results. In removing such a tumour, the surgeon must remove every portion of it, or a recurrence may take place. It is well to remember that diverticula are occasionally present, and that bursal cavities may exist in several planes, and intercommunicate through openings in the fasciæ or aponeurosis. This is seen most frequently in enlargement of the bursa patellæ.

Acute inflammation of a bursa: Acute bursitis.—This usually results from an injury, and is due either to a single heavy blow or to excessive abnormal pressure. It may affect for the first time a bursa that is normal in structure; or a chronically enlarged bursa of some standing may become acutely inflamed from being exposed to a degree of pressure largely in excess of that which originally determined its enlargement. As an instance of the latter

condition, the bursa which develops over the inner part of the head of the first metatarsal bone when the toe is displaced outwards—hallux valgus—readily becomes acutely inflamed, and occasionally suppurates when exposed to an unusual amount of pressure. A sudden strain may bring about a very painful acute inflammation. One of the varieties of “tennis elbow” depends on an acutely-inflamed condition of the bursa between the biceps tendon and the tubercle on the radius.

Again, a bursa may become acutely inflamed, and may suppurate by becoming involved in an infective cellulitis which has started in the connective tissue in its vicinity. Or a normal or already enlarged bursa may be laid open by a wound, and so infected, an acute suppurative process resulting.

Treatment.—If the inflammation be not acute, it will subside with rest and cooling lotions, assisted subsequently by counter-irritation.

If there is any evidence of suppuration, the tumour should be laid freely open and packed with gauze.

In some cases, where an old enlarged bursa has become acutely inflamed, a complete excision may be the best treatment.

Bunion.—The term *bunion* is usually applied to the bursa which develops over the inner part of the head of the first metatarsal bone, where, owing to the outward displacement of the first phalanx by the form of the boot, the sensitive cartilage covering this portion of the bone is exposed to an unaccustomed pressure. This bursa may inflame and suppurate, and the abscess so formed may extend into and involve the metatarso-phalangeal articulation.

As age advances, the articular cartilage over the uncovered portion of the head becomes replaced by synovial membrane, and then by periosteum. The inner half of the head of the bone wastes, and the bursa disappears, there being no longer any necessity for its existence.

Treatment.—To alleviate the pain which results from the inflammation of the bursa, all pressure upon the sensitive articular cartilage must be removed by altering the form of the boot, or by placing the phalanx in its original relationship to the head of the bone by means of some mechanism alone, or combined with operative interference, such as the subcutaneous division of all the soft parts which oppose restitution. In more advanced cases the joint may be excised partly or completely, or the atrophy that takes place in advanced life may be brought about at once by cutting away the inner half of the head of the bone with a chisel. This last method is apparently the most scientific, and is very effectual. The form of treatment to be adopted must vary largely with the degree and duration of the deformity, and with the sex, age, and circumstances of the patient.

Tuberculous disease of bursæ.—Bursæ may be affected primarily with tuberculous disease, or secondarily. The latter is seen frequently in the distension of the bursa between the inner head of the gastrocnemius and the semi-membranosus with tuberculous material in the like disease of the joint. Such a bursa is, however, merely a diverticulum of the synovial membrane of the knee joint.

The bursa under the gluteus maximus and over the great trochanter of the femur would appear to be affected with tubercular disease more frequently than any other. Though in many cases such a condition is primary, yet in a large number this cavity is infected by disease commencing in the epiphysial line of the great trochanter. As the orifice of communication may be small, the disease of the bone is very frequently overlooked.

The bursa between the tendo Achillis and the os calcis is also liable to be affected primarily, or by extension from disease in the os calcis.

The bursa patellæ, which is so liable to suffer from injury, appears to possess a peculiar and not easily explicable freedom from tuberculous disease.

The treatment of such tuberculous conditions does not differ in principle from that of like disease elsewhere.

Syphilitic affections of bursæ.—Rarely, as in the case of the tendon sheaths, effusions into the bursæ over the patella and olecranon have been observed during the secondary stage.

As tertiary manifestations, affections of bursæ are by no means uncommon, and may develop many years after infection. Perhaps the bursa most often affected is that over the patella: probably for the reason that it is the one most exposed to injury. Several nodular masses of gelatinous new formation are present, or the enlarged bursa may be uniform, and of the same gelatinous structure throughout. Then gummatous masses may involve and destroy the skin, and a characteristic undermined ulceration with a yellow slough results.

Again, bursæ may be involved secondarily to gummatous formations in the adjacent subcutaneous tissue, bone, or joint.

Primary gummatous bursæ may be mistaken for chronically inflamed bursæ, for tuberculous bursitis, for subcutaneous fibrous tumours, and for sarcomata.

XXXV. THE SURGERY OF DEFORMITIES.

By H. H. CLUTTON, M.B. Cantab., F.R.C.S.,

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General principles.—Many of the deformities are *congenital*, whilst others are *acquired* as the result of some previous disease. The history which the parents are able to give will generally settle this point if it be a matter of doubt, but, as a rule, the case is sufficiently obvious without such information. Most of the congenital deformities—such as talipes—require treatment at the earliest possible moment; whilst in some of the acquired, at any rate, the treatment should be primarily directed to the disease which is giving rise to the deformity.

In the *treatment* of a confirmed deformity, instrumental aid should be used as little as possible. There are cases in which such assistance is essential, but wherever operative treatment appears likely to be successful, it should be tried, for it may do away with the necessity of a lifelong burden. This is especially the case at the present time, when operations are not attended with the risks which were only too obvious some years ago. For example, if an osteotomy would probably do away with the necessity of wearing an instrument, it should certainly be preferred, for in the hands of a skilful surgeon it is practically free from danger.

Treatment must be revised in this, as in other branches of surgery, simply on account of the favourable course which all operations follow under modern aseptic conditions. An operation which was considered impracticable a few years ago may now, oftentimes, be looked upon as the ordinary line of treatment. These remarks especially refer to the treatment of deformities which was notoriously unsuccessful before the Listerian era of surgery. Cases for which instruments only could be ordered are now daily submitted to the surgeon's operative skill, and with manifest advantage to the patient. Plaster of Paris in the after-treatment has also enabled the surgeon to omit cumbersome appliances, which required frequent alteration to avoid pressure-sores and pain. ● No fear is now entertained as to the immediate rectification of a deformity which formerly occupied weeks or months. After operation, the limb is at once placed in the fully-corrected position, whether it be a tendon or a bone which

has been divided, and the moulded plaster maintains this position without undue pressure at any one spot, and does not require changing till the wound has healed. This is an enormous gain to the patient, who formerly had to submit to daily slight and trivial alterations, which caused excessive pain, to bring the limb slowly into the corrected position.

Wry neck. Causes.—Torticollis, or wry neck, must not be made to include the deformity due to cervical caries, nor the reflex spasm of muscle from a deep-seated abscess in the neck. There must be real shortening of muscle and tendon before the term wry neck is applied to any given case. The principal muscle affected is the sterno-mastoid, and probably in its earliest stage the only muscle involved. But in old-standing cases other muscles—such as the trapezius, scaleni plenius, and complexus—and finally the sub-occipital muscles are secondarily shortened from long-continued approximation of their origins and insertions.

It has been customary to speak of congenital wry neck as if a child was born with this deformity, but this must be the rarest event, for I have not seen such a case. No doubt it arises soon after birth, and in most of these cases it will be found that there has been a lump or swelling in some part of the sterno-mastoid—the so-called *congenital tumour of the sterno-mastoid*—which has been shown to be due to stretching or partial rupture of the fibres of this muscle during parturition. Delivery with forceps or by the breech necessarily entails severe traction on the muscles of the neck. (See page 7.)

Tuberculous glands in infancy or childhood beneath the sterno-mastoid, which persist for an indefinite time and leave traces behind in the form of puckered cicatrices, also account for a certain number of shortened muscles.

These two causes, in my opinion, are far the most important, as they are the most common incidents in the history of wry neck.

There is no evidence to show that the nervous system has anything to do with this condition. The changes in the face, etc., which will be described a little later, may be accounted for in another way.

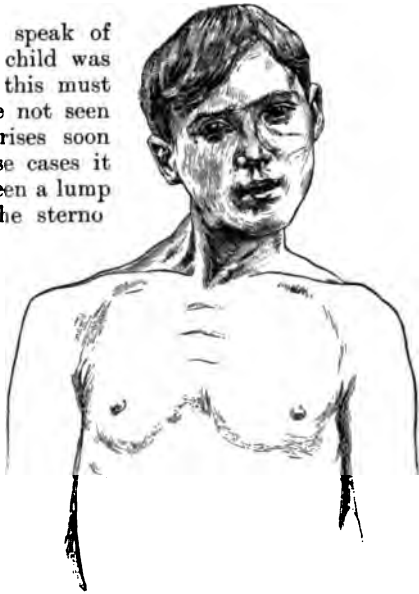


Fig. 481. — Boy, aged 17, under the writer's care, in whom Wry Neck commenced after an abscess at seven months of age beneath the right sterno-mastoid. An old and puckered cicatrix existed in this position.

Symptoms.—The posture of the head (Fig. 481) is that in which it would be placed when the sterno-mastoid muscle is fully contracted by voluntary action. The head is laterally inclined towards the shoulder of the same side, whilst the face is turned in the opposite direction, with the chin raised and the whole face obliquely placed with regard to the anterior surface of the body. In extreme and long-continued cases, the side of the head is not only drawn down towards the shoulder, but the latter is raised, probably from the

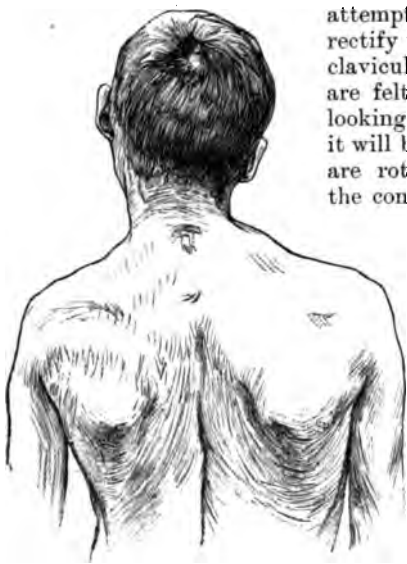


Fig. 482.—Same patient as in Fig. 481, showing the prominence of the cervical vertebræ to the left of the median line.

associated action of the trapezius. If an attempt is made with the hands to rectify the position, both the sternal and clavicular portions of the sterno-mastoid are felt as hard and rigid bands. In looking at the back of the neck (Fig. 482), it will be seen that the cervical vertebræ are rotated and curved laterally with the convexity to the opposite side. The

face is also unsymmetrical, from want of development on the side affected. This half of the face is smaller and shorter in every dimension, so that the eyebrow is nearer the chin than on the opposite side. There is no reason to think that the central nervous system has anything to do with this deficient development. It probably arises from the more exposed part of the face doing duty for the whole. It is more exposed to light, and is, as it were, the speaking part of the face, whilst

the lower half remains comparatively in the shade.

Diagnosis.—In the diagnosis of wry neck it is necessary to remember that it may be simulated by the reflex spasm of cervical caries. In the latter disease it will be found that *all* the movements of the neck are restricted, whereas in wry neck only one sterno-mastoid is affected, and put upon the stretch by a movement in one direction. The pointing of the chin in wry neck is away from the muscle affected, whereas in caries the chin nearly always points over the very muscle which, at first sight, appears to be shortened, but which, on careful examination, is found not to be more rigid than the other muscles. An inflammatory swelling beneath the muscle will be sufficiently obvious, on manipulation, to make this a matter of little difficulty in diagnosis. The head will incline to that side, but the muscle will not stand out as a rigid bar across the neck, for every effort will be made to keep the muscle in a state of relaxation.

Treatment.—Tenotomy or myotomy must be done, and to its fullest extent, so that no tense bands are left at the end of the operation. Till recent years the subcutaneous method of dividing both the sternal and clavicular origins of the sterno-mastoid was universally adopted. But most surgeons will agree in thinking that really the open method, in dealing with this deformity under the present system of surgery, is far less dangerous than a complete subcutaneous division. After the tendinous insertion along the clavicle has been divided, bands of fascia can be still felt, which are easily dealt with through an open wound, but are often left undivided if the operation is done by the subcutaneous method.

Some surgeons, recognising this difficulty, have divided the muscle in the middle of the neck. This also can be best executed through an open wound. But in adopting this operation the tense fascial bands in the lower part of the neck are left undivided, which are still apparent after the muscle has been completely severed.

No special apparatus is required after this operation. The dressing having been applied, the head should be fixed for a fortnight in such a way as to produce the widest separation of the divided structures. A piece of house-flannel soaked in plaster-of-Paris and folded, extending from the side of the head just above the ear to the top of the shoulder, will be found the most certain way of producing this result. At the end of a fortnight, when this is removed and the wound is healed, manipulation, gentle massage, and the patient's voluntary movements will be sufficient to bring the case to a successful issue. The patient must, of course, be watched for a few months to see that the exercises are being carried out, and that there is no recontraction. I have not for many years used any apparatus of any kind, and have always seen a steady and progressive improvement by this simple method of treatment.

Spasmodic wry neck.—This is a totally different disease to the ordinary wry neck just described. There is no shortening of muscle, but a spasmodic action of the muscles of the neck, which may be either tonic or clonic. It sometimes commences as a "habit spasm," but in most cases there is no clear evidence as to its cause or origin. It is probably dependent upon changes in the cells from which the nerves supplying the muscles affected arise. Although the sterno-mastoid is most frequently affected, other muscles may be involved. The upper part of the trapezius on the same side is more often associated with the sterno-mastoid in this troublesome affection than any other muscle, as one might expect from its nerve supply. But the deep muscles which rotate the head may also be involved, the splenius, complexus, recti, and obliqui of the opposite side being then generally associated with the sterno-mastoid and trapezius. If the deep muscles in the suboccipital region are affected on *both* sides, nodding movements are produced. The spasms may be tonic, holding the head in a fixed position for a variable length of time; or clonic and rhythmical, producing a great variety of nodding or rotatory movements of a peculiar and often grotesque character.

Treatment.—After general and medical treatment have had a fair trial, an operation should be undertaken. Simple stretching of the spinal accessory nerve has not been successful for this spasmodic action of the sterno-mastoid and trapezius, but excision of an inch or more of this nerve by an incision in front of the sterno-mastoid, commencing immediately below the mastoid process, has been attended with a fair amount of success.

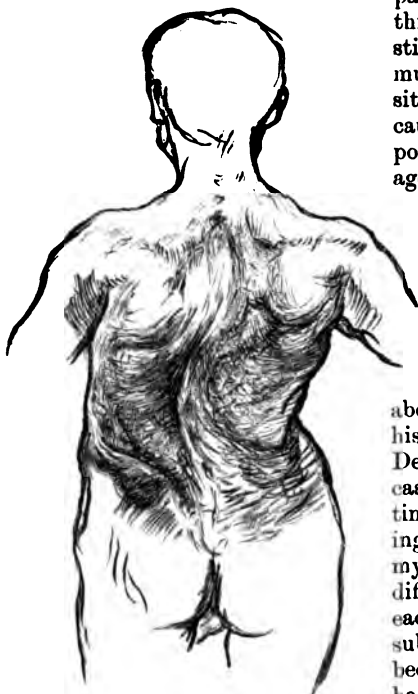


Fig. 483.—Lateral Curvature of the Spine. (St. Thomas's Hospital Museum.)

In some cases, although partial relief has been obtained in this way, rotatory movements have still continued. The posterior muscles of the neck on the opposite side are then likely to be the cause of the symptoms. This was pointed out by Ballance as long ago as 1886 in "St. Thomas's

Hospital Reports," vol. xiv. But Keen* was the first to publish an account of a definite operation for the division of the posterior cervical nerves supplying these muscles. The reader must be referred for a full description to his article

above alluded to. The report of his first case was published in December, 1889. Since then cases have been recorded from time to time in the journals, showing very favourable results. In my experience it may be very difficult to reach and demonstrate each nerve before division, if one sub-occipital region has already been treated. The first wound having healed makes it difficult to retract the muscles on the opposite side. It would be much easier to operate on both sides at

the same time. The muscular paralysis which, it might be thought, would be conspicuous after these operations, has been shown to be scarcely noticeable.

Lateral curvature of the spine; Scoliosis. Causes.—This deformity is not a pure lateral curvature of the spine as its name implies, but one accompanied by more or less twisting or rotation of the bodies of the vertebræ (Fig. 483). Although known as a congenital deformity, it is as an acquired condition that we shall allude to it in this article. The spine is a flexible, many-jointed column, of which

* "Annals of Surgery," January, 1891.

the individual parts are held together by ligaments, and supported during its complicated movements by muscles. If the ligaments were really so tightly stretched as of themselves to keep the vertebræ in their proper relation to one another during the movements of the body, then the spine would not exhibit its peculiar mechanism—namely, its flexibility. The disease in question undoubtedly arises from *muscular exhaustion* or fatigue. The muscles ceasing to take their proper share in maintaining the erect position, the whole stress is thrown upon the ligaments, which eventually yield to the abnormal strain, and allow the spine to be bent from the superincumbent weight. The curvature thus produced is in great measure influenced by the attitude of the patient, who naturally assumes in standing or in sitting the posture of greatest ease. It requires a muscular effort to keep the spine erect. Antero-posterior curvature might at first sight be thought to be the most likely result of this muscular relaxation. No doubt stooping shoulders or kyphosis, with the head poking forwards, is the simplest and most easily explained deformity, arising from muscular fatigue. But, considering the manifold duties the body has to perform, whether the muscles be tired or not, it is easy to see that a lateral deviation may be caused by various postures naturally assumed during this period of exhaustion (Fig. 484). Standing on one leg, the use of the right arm in preference to the left, sitting at a table with one shoulder higher than the other—have all received their advocates, to account for this lateral deviation of the spine in supporting the weight of the body. Probably all combine to produce the same result.



Fig. 484.—Lateral Curvature of the Spine.
(St. Thomas's Hospital Museum.)

Although the above description accounts for the largest proportion of these cases, there are one or two other points to which allusion should be made. *Rickets* may be responsible for lateral curvature in an infant, although, as a general rule, the deformity is antero-posterior. But both arise from muscular relaxation, which is a characteristic feature of this disease. *Shortening of one leg* from any cause, such as disease of bones and joints or a congenital imperfection, may throw the pelvis into an oblique position, and give rise to a compensatory curvature of the spine. Contraction of one side of the chest from an *old empyema* will also cause a marked deformity

of the spine which generally consists of one long dorsal curvature with the convexity to the healthy side. There is much less rotation than in an ordinary case of scoliosis, and the compensatory curves in the cervical and lumbar region are short.



Fig. 485.—Skeleton from a case of Lateral Curvature of the Spine. (St. Thomas's Hospital Museum.)

The changes in the spine.—Rotation, which always accompanies the lateral curvature, arises from the interlocking of the articulation. It is also a much easier movement for the spine to rotate slightly when lateral bending has to be accomplished. Therefore, to assume the easiest posture when the muscles allow the spine to “topple over,” rotation of the vertebræ always takes place. In this rotatory movement the bodies of the vertebræ turn towards the convexity of the curve, whilst the spines are directed to the concavity. The vertebral articulations for the ribs in this movement are carried backwards on the convex side of the curvature. The angles of these ribs are thus unduly prominent, and form the chief feature of the deformity. (*See* Figs. 485 and 486.) A curve, having once begun, necessarily increases from the weight

of the body acting with greater advantage upon a curve than upon a straight line—unless, of course, some remedial measures are taken to strengthen the muscles. As the disease arises in a growing spine before ossification is complete, the bodies of the vertebræ undergo some alteration in their development. They are unnaturally squeezed together on the concave side, and do not reach

so full a degree of growth as on the convex side of the deformity, which may thus become in great measure a confirmed condition.

We have so far spoken of this curvature of the spine as



Fig. 496.—Lateral View of Skeleton in Fig. 485, showing the extreme rotation of the bodies of the vertebrae.

if it were single ; but this is not the case. Whenever the spine curves laterally and with rotation in one direction, there must be a compensating curve in the opposite direction, or the body would not even have the semblance of being upright. As a general rule, the

higher curve is in the upper dorsal region and to the right, whilst the lower is in the lumbar and to the left. Much discussion has taken place as to the priority of these two curves: one party asserting that the dorsal curvature is the primary deformity, whilst the other states that the converse is the case. It may well be left for still further speculation.

The *secondary effects* of rotato-lateral curvature of the spine are most marked in the alteration of the capacity of the chest. As already described, the ribs are carried backwards on the convex side from rotation of the vertebræ. They also diverge from one another, whilst the ribs on the opposite or concave side are crowded together and depressed. The cavity of the chest is much diminished and its movements much restricted by the altered position of the ribs and their articulations. In advanced cases of this deformity the breathing is almost entirely diaphragmatic.

Clinical features.—The physical condition which causes this deformity commences during childhood and youth, but its results, so far as deformity is concerned, are recognised somewhat later in life. Whilst the body is increasing rapidly in size, a greater strain in proportion to its strength is thrown upon the muscular system than at any other time of life. It is much more common in girls than boys, for the simple reason that they are not so well accustomed to physical exercises, which develop the muscles in proportion to the growth of the body. As the public are beginning to recognise this fact in the education of girls, it will be interesting to see if any difference in years to come will be noticed in the proportion with which the two sexes are affected with this deformity.

We will assume, for the purposes of our description, that the patient is a young girl. No complaint is, as a rule, made of pain, but the patient is brought for advice on account of her appearance or awkward gait. Her shoulder or hip, or possibly both, are said to be "growing out." This leads at once to an examination of the spine. The patient should be stripped to the waist, with the brim of the pelvis fully exposed. The posture then assumed is, as a rule, quite characteristic. The right shoulder will be higher and more prominent than the left if the convexity of the upper curve is to the right, as is usually the case. The ribs being more prominent on this side, for reasons already given, naturally make the scapula project. The crest of the ilium on the opposite side will also be more prominent, from the lumbar curve having its convexity in that direction. If the examiner now places his hands on the pelvis, he will see if the two anterior superior spines are on a level. Should one be higher than the other he will think of an inequality of the lower limbs as a possible cause of the curvature. This may arise from a congenital irregularity, as the two limbs are not always of equal length. Or some previous disease now quiescent, such as of the hip joint, may have diminished the rate of growth on one side. Inquiries into the history and the measurement of the two limbs

in the horizontal position in the usual manner, will settle this question of inequality. The patient, now standing as before, with her back to the examiner, is made to hold herself as erect as possible. In some cases, especially in the early stage, the patient is able for a short time to assume a much better position, but will

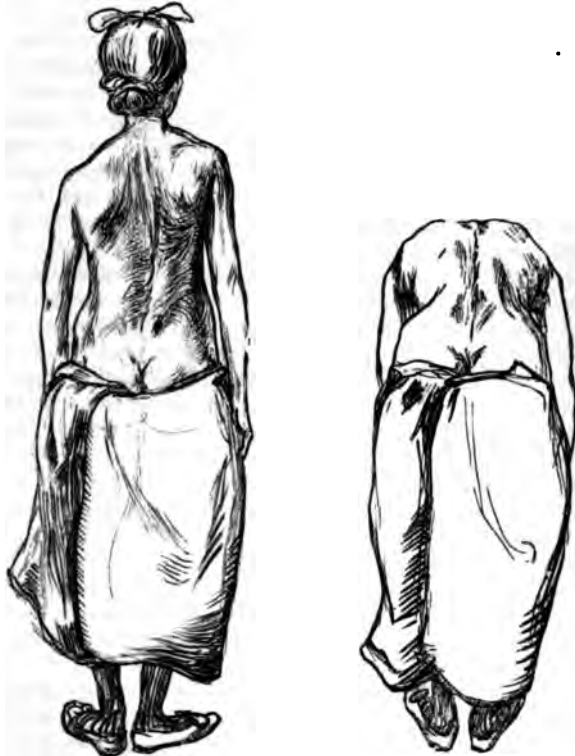


Fig. 487.—Patient with slight Lateral Curvature of the Spine, which almost disappears in stooping forwards. But it will be noticed that the angles of the ribs in the dorsal region are still a little more prominent on the right than on the left side.

quickly relapse again into her former awkward posture. To see how far the spine can return to its normal position, the patient is then directed to stoop forwards with the feet together, the knees kept straight, and the arms hanging loosely by the side and in front (Fig. 487). If the rotation of the vertebræ is not confirmed, the back will present the same features as in health, one spinous process succeeding another in a straight line, whilst the prominence caused by the angles of the ribs on the side of the convexity will entirely disappear. But, as a rule, by the time the patient comes under observation the rotation of the vertebræ, even in the stooping position, is

still a noticeable feature. The scapulæ having glided forwards, it is now easy to estimate the amount of this rotation. In the dorsal region the angles of the ribs can be seen and felt as a prominent ridge by the side of the spinous processes. In the lumbar region the transverse processes are felt projecting on the opposite side. The examination of the spine being completed, the feet should be inspected for flat foot, which is a common accompaniment of lateral curvature, and arises at this age from the same cause.

Treatment.—Systematic exercises of the muscles of the trunk should be made the rule of practice. Spinal jackets and supports can only still further enfeeble the muscles and perpetuate the deformity, if it does not make it worse. Exercises and massage, on the other hand, will develop the muscles, and render them better able to keep the body erect. If the spine is already fixed in an unnatural position, exercises will relieve pain, take away the sensation of fatigue, and prevent the deformity from increasing.

In the early stage, when the patient is obviously weak, these exercises should be combined with periods of rest in the recumbent position. I have seen cases where exercises have been continued so long at a time, and with so little rest, that sleep has been prevented at night from sheer exhaustion, and the appetite has also failed. Clearly, in such cases, this excellent treatment has been overdone. Much also can be accomplished at home in correcting faulty attitudes, particularly during sitting and writing. A chair should be provided that really supports the back when sitting at table or at the piano, and the desk for writing should be inclined in such a manner as to prevent slouching. The best systematic exercises are these known as "Ling's system." They should be carried out by some one who will take trouble and inspire energy in the patient's mind and movements. For this reason a class is not suitable for a patient with lateral curvature, as the movements are likely to be more or less perfunctory, and done in a listless way. The reader who is unacquainted with these exercises is recommended to obtain Captain Haasum's "Manual of Free-standing Movements" (published by Hachette & Cie.), or Miss Arnim's publications (Swan, Sonnenschein & Co.), or Alexander's books on exercises for girls and boys at different ages (Geo. Philip & Son).

Massage of the spinal muscles by a professional rubber, who is also thoroughly familiar with these exercises, is one of the best ways of obtaining a good result. Special exercises for the spine with resistance by an assistant must be taught and continued for months, or even longer in obstinate cases.

As before stated, these exercises should not cause fatigue which cannot readily be removed by half an hour's rest in the recumbent position. This should always be insisted on at the commencement of the treatment, and for many months, if found to be necessary.

Gymnastic exercises with trapeze or "home exerciser" will be found advisable, in addition to the above, for cases of contracted chest and lateral curvature after an old empyema. General treatment

must not be neglected—particularly fresh air, wholesome food, and some simple tonics.

Antero-posterior curvatures of the spine.—**Kyphosis**, or posterior curvature without caries, is seen as an exaggeration of the normal dorsal curve of the spine. Sometimes this is the result of an occupation, such as that of a tailor who sits cross-legged on a board. The patient is generally described as “round-shouldered,” and appears to be stooping with the head carried forwards over the chest. It arises from the same causes as in lateral curvature, and is to be treated in the same manner. It is accompanied by a compensating curvature in the lumbar region, which is called “lordosis.”

Kyphosis from muscular relaxation is distinguished from the deformity of Pott's disease by the absence of pain or tenderness on pressure, and by the fact, in the early stage, that the vertebræ are still movable. If the patient is directed to stoop and then assume the erect position whilst the surgeon's fingers are placed upon the spines, these processes can be felt to move, whilst in caries no such movement can be detected. In old-standing cases, when the muscles have been shortened from long-continued deformity, this mobility may be absent. But there is then a history to guide the surgeon to a correct conclusion. The curvature is also more uniform and general, whilst in caries there is almost sure to be one spot more prominent than another.

This exaggeration of the dorsal curve is also seen in adult life, from sedentary occupations, and in old age.

Lordosis is an exaggeration of the normal lumbar curve of the spine. As already mentioned, it occurs as a compensating curvature to kyphosis. In caries of the upper part of the spine it is also common, for the same reason. In all flexures of the hip, whether from muscular rigidity as in the early stage of hip disease, or in ankylosis when the disease has ceased, lordosis is generally present. In congenital dislocation of the hip, the “hollow loin” is a prominent feature of the deformity.

In many paralytic conditions, as in infantile paralysis and pseudo-hypertrophic paralysis, it is well marked, from the inability of the muscles affected to keep the spine erect.

Lordosis being, in the vast majority of cases, a compensating curvature to bring the upper part of the spine back into the line of the centre of gravity, the treatment should be directed to the primary condition which has given rise to the lordosis. The treatment of the paralytic variety is conducted on the lines which would be adopted for the particular paralysis which has given rise to the deformity.

Acrobats, from excessive use and constant practice, acquire an abnormal mobility of the lumbar region of the spinal column. They habitually walk with some degree of lordosis.

Pregnant women, and those afflicted with a large, fatty, and pendulous abdomen, are obliged to balance this weight by throwing

the upper part of the trunk backwards. They therefore temporarily acquire, for physiological reasons, the same deformity.

The kyphosis and lordosis of rickets is described in the Article on RICKETS, p. 368, Vol. I.

Club-hand.—This is a very rare deformity, and is not comparable with club foot, for it is nearly always due to a deficiency of either the radius or ulna (Figs. 488 and 489). In most cases the radius is wholly or partially absent, and the hand articulates with the lateral aspect of the ulna. (*See* pages 51 and 89.)

An apparatus to render the hand more serviceable is the only treatment that can be recommended.



Fig. 488.—Club Hands, from the radius being absent on one side and undeveloped on the other; from a baby a few months old, who died under the writer's care, and from whom the specimens (Fig. 489) were obtained, post mortem.

Congenital club-foot.—The congenital varieties of club-foot require the first consideration. Pure flexion and extension of the ankle joint are neither of them common as congenital deformities. Talipes calcaneus, or flexion, with the dorsum of the foot applied to the front of the leg, and the heel projecting downwards, is almost always associated with a variable degree of valgus, or eversion of foot. Talipes equinus, or extension, with the heel drawn up and the toes pointing downwards, is always combined with varus or inversion of the foot. The deformities may thus be considered under two headings—talipes equino-varus and calcaneo-valgus. And of these the former is the common congenital club-foot, whilst the latter is comparatively rare.

Ætiology.—Much has been written on the causation of these deformities, but space will not permit of more than the briefest reference to the various views that have been advanced and that are still held by many. Their origin in some disorder of the nervous system, producing paralysis of one set of muscles or spasmodic

contraction of another or opposing set, has perhaps till recent years been the most popular view. The bones, altered as they are acknowledged by all to be, have been thought by others to be the cause and not the effect of the deformity. But the most interesting explanation, as it is also the most reasonable, is that which has been so ably advanced by Messrs. Parker and Shattock.* This, the mechanical view as we may call it, supposes that the feet in utero are maintained from some accidental cause beyond the normal period of time in a particular position, and that thus the ligaments and muscles are stretched on one side and shortened on another, so that they cannot subsequently be rectified by nature. It is known that in early foetal life the feet are inverted (talipes varus), whilst later the position is one of flexion (calcaneus). For the normal development of the feet they should pass from one position to another. If anything interferes with this transition, they become permanently fixed in an abnormal position.

1. Congenital talipes equino-varus.

Pathological anatomy.—

In this deformity there is marked inversion of the foot with extension of the ankle joint. The inner border of the foot is raised so that the sole looks directly inwards, and in extreme cases may even look backwards. The outer border is depressed, so that if the child were old enough to walk, the outer border and dorsum of the foot would be presented to the ground (Fig. 490). The equinus is not so obvious at first sight till the anterior part of the foot is brought round to a straight

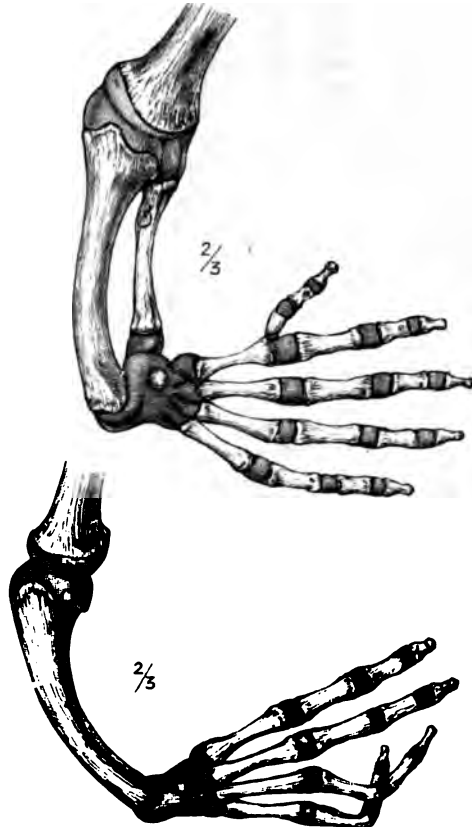


Fig. 489.—Specimens of Fore-arms and Hands from the case shown in Fig. 488. The upper specimen shows the left radius and first met-carpal bone undeveloped; the lower shows the absence of the right radius and thumb.

* Path. Soc. Trans., 1884 "Congenital Club-Foot," by R. W. Parker, 1887.

line with the leg, when it is at once seen that the heel is raised and that the toes are pointing downwards.



Fig. 490. — Double Congenital Talipes Equino-varus. From a patient, aged 11 years, under the writer's care.

ankle joint (Fig. 491). The bones are kept in this position by shortened muscles and ligaments. Long-continued approximation of the origin and insertion of a muscle leads to an adaptive shortening. If the theory of intra-uterine position is the cause of this deformity, neither muscle nor ligament can be said correctly to be shortened, as they have never been longer. But they have never had the chance of developing to their normal length. Be this as it may, the bones cannot be brought into their proper relative position till both

The most important structural deformity is that of the astragalus. The superior articular surface is prolonged backwards, whilst the neck is abnormally long and inclined inwards and downwards. The inner malleolar facet is also prolonged, so as almost to meet the articulation for the scaphoid. This position of the astragalus is the normal condition in the anthropoid apes, where the inversion of the feet is essential for their particular method of progression. The os calcis is also curved in the same direction, carrying with it the cuboid and the other tarsal bones. The result of this inversion of the foot is that the scaphoid is brought close to the internal malleolus of the tibia, and often touches it. The head and neck of the astragalus are then exposed on the dorsum of the foot, and may form the chief projection in front of the

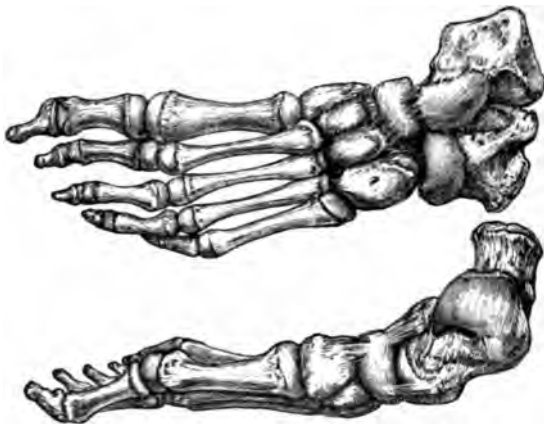


Fig. 491.—Skeleton of a Child's Foot, showing the condition described in the text. (St. Thomas's Hospital Museum.)

tendons and ligaments have been divided. The most important tendons are those of the gastrocnemius, tibialis posticus and anticus, abductor pollicis, flexor longus pollicis, and the flexors of the toes. But after these tendons have been divided, the bones are still firmly held together in their abnormal position by the ligaments. The calcaneo-scaphoid ligament and the anterior half of the deltoid ligament, which joins the former, are probably the most important structures in this respect. The long and short plantar ligaments are also made tense in everting the foot. The plantar fascia can always be felt as an unyielding structure to any force from the hand. The equinus part of the deformity is not only maintained by the gastrocnemius, but by the posterior ligament of the ankle joint. The skin is also abnormal, for if any attempt be made to bring the foot into its proper position, it becomes tense almost to bursting on the inner side, whilst on the outer it is thrown into wrinkles. A large bursa and thickened skin are also found over the prominent cuboid on the outer side and dorsum of the foot in untreated or relapsed cases that have been allowed to walk.

Treatment.—Mechanical contrivances, such as Scarpa's shoe, are in my opinion undesirable for the curative treatment of congenital talipes.

Manipulation from the first moment that it can be commenced is the most important treatment that has to be learnt by the mother or nurse, and must be continued without flinching for some years. The surgeon must see it done over and over again till he is quite sure that the lesson has been learnt. The leg is grasped firmly just above the ankle by one hand, whilst the other carries the front of the foot firmly and with some force into the correct position, and, if possible, beyond this towards eversion. In some slight cases the deformity may in this way be entirely corrected. If little progress is made, and the foot at once returns each day to its former position, and requires the same force as before for its restoration, it may be placed in a plaster-of-Paris bandage in the best possible position for a month, using considerable force with the hands, but applying the bandage as gently as possible for fear of causing pressure-sores. A hint, which I learnt from Mr. Herbert Milton, of Cairo, when he was house surgeon at St. Thomas's Hospital, is of value for this bandage. In order that it may be unwound as easily as it is put on, it is only necessary to take two bandages, and having placed the end of each one above the other with the plaster-of-Paris dusted in between them, to re-roll them into one bandage.

Operation.—When is this to be done? In some bad cases it is obvious from the first that this will be necessary, but it is wisest to commence with manipulation, and to obtain as much improvement from this treatment as possible, combined with plaster of Paris during the first few months of infant life before proceeding to operation. If manipulation has been successfully accomplished, and the inversion in great measure corrected, the tendo Achillis and

the posterior ligament of the ankle joint may alone require division. When the tendon is divided, the tenotome (double-edged) should always be passed deeply to the posterior articular margin of the tibia. If the proper spot has been selected and the ankle joint flexed, the interval is easily found, and the knife made to cut from side to side through the whole breadth of this ligament. A snapping sound is heard when forcible manipulation is employed, and the foot is then placed in the calcaneal position and retained by plaster of Paris. This operation is done by the subcutaneous method through a mere puncture of the skin. But if the deformity cannot be fully corrected and the foot placed in the opposite or calcaneal position, with the heel depressed—and this is especially the case in old and relapsed deformity—there should be no hesitation in making an open wound on modern lines, and dividing whatever hinders the correction. In many of the slighter cases of talipes equino-varus this is all that is required, and the foot can be fully everted as well as flexed.

But in extreme cases of this deformity, and in those in which manipulation has not been employed from the first day of infant life, something more is required to correct the inversion of the foot. Till recently the tendons of the tibialis posticus and anticus were separately divided by the subcutaneous method, and always before the tendo Achillis, on the supposition that the heel could be used as a fixed point, from which to unfold the arch of the foot. Since Prof. George Buchanan, of Glasgow, and Mr. R. W. Parker, have rightly insisted on the division of these structures with the ligaments and plantar fascia in front of the internal malleolus, it has been felt by most surgeons that the tendo Achillis should be divided first, for otherwise it would be difficult to know how much ought to be divided in the sole of the foot to procure the desired result. This is more especially the case at the present time when the subcutaneous method is being superseded by the open operation.

The method, then, that we would advise after manipulation and plaster of Paris have failed, and an operation is contemplated, is—firstly, the subcutaneous division of the tendo Achillis and posterior ligament of the ankle joint. This is almost sure to be successful in bringing the foot up beyond the right-angle. If, however, this position is not obtained, an open incision should be made in the most approved aseptic method, and dissection carried down to the ankle joint through the divided tendo Achillis.

Secondly, the foot having been brought to a right-angle or beyond this point—and the deformity being still uncorrected—an incision should be made at the inner border of the foot through all the structures down to the tarsal bones, commencing upon the dorsum just in front of the internal malleolus, and continued transversely to the centre of the sole (Phelp's operation). This incision will divide the tendons of tibialis posticus, and possibly that of the anticus, the abductor pollicis and the flexor longus pollicis. It should also open the joint between the head of the astragalus and

the scaphoid, dividing the anterior portion of the deltoid ligament. Continuing to the centre of the sole of the foot, it should divide all the structures, such as the plantar fascia, flexor brevis digitorum, the accessorius, the tendons of the long flexor, if they appear to be tense, and the internal plantar nerve and artery. Care should be taken to stop short at the external plantar nerve, which, with careful dissection, can be recognised in this gaping wound. The long and short plantar ligaments may then be divided, and the foot placed in an everted position. The gap is filled with antiseptic or aseptic gauze, and the foot enveloped in a voluminous dressing. In a few days, when oozing of blood has ceased, the raw surface may be covered with skin transplanted by the Thiersch method, and the foot placed, fully everted, in plaster of Paris. It is undoubtedly true that this open wound and eversion of foot may be carried so far as to convert the varus into a valgus. This should be avoided, as the front part of the foot then loses its power of supporting the weight of the body when the heel is raised from the ground in walking. Some surgeons, on that account, still assert that this incision should be a subcutaneous one, as the undivided skin will prevent too much eversion. And there is no reason why this incision should not, in the first instance, be subcutaneous. But if it fails to correct the deformity, it should be converted into an open wound, and then, if a valgus foot be feared, the head and neck of the astragalus may be excised with the chisel through the same wound. This method has yielded excellent results, in my experience, and quite overcome the objection above alluded to (Fig. 492).



Fig. 492.—Double congenital Talipes Equino-varus. From a patient, aged 6, under the writer's care (1892). The right foot has been corrected by Phelps's operation. The left foot was subsequently submitted to tarsectomy. Both feet had been treated before by operation, and had relapsed.

Relapsed and inveterate cases.—All surgeons are familiar with cases of extreme deformity at advanced ages where operations at an earlier period have already been done, and from subsequent neglect have relapsed. If on examination it is seen that the deformity is now maintained by structural alteration in the tarsal bones, a wedge must be removed from the arch (tarsectomy) or the astragalus excised. For these operations the reader is referred to works on operative surgery. But in my experience Phelps's operation coupled with the removal of the head and neck of the astragalus through the same wound, has produced even in these cases a most serviceable foot, which compares favourably with the best results after tarsectomy.

After-treatment.—Parents should be impressed with the absolute necessity of continuing manipulation and massage after the deformity

has been rectified. The case is otherwise almost sure to relapse. In most instances it will be necessary to order some form of support to maintain the foot in the corrected position for some years. The foot may be plantigrade and the deformity apparently corrected, and yet there may be inversion of the whole foot and leg, which will be recognised by the position of the patella. An osteotomy at the junction of the middle and lower third of the tibia will enable the surgeon to correct this inversion by rotation of the lower portion.



Fig. 493.—Compound Aluminium and steel Retentive Night Shoe, for use after cure of Talipes Equinovarus. It consists of a long spring to rotate the foot outwards and a thumbscrew movement to permit mobility upwards, but still retain the foot at right-angles. (By Ernst.)

The patient will otherwise knock one foot against the other, or acquire a habit of walking which is of itself a deformity. An apparatus which is carried to the waist can be made to try to correct this deformity, but it is very unsatisfactory. Where this inversion does not exist, good boots and double leg-irons to the knee will be sufficient. At night, also, some retentive apparatus (Fig. 493) should be worn, for the foot falls into its old abnormal position from gravitation.

Prognosis. — This entirely depends upon the intelligence with which the directions are carried out.

Patients of the age of eighteen or over occasionally present themselves with this deformity, who have never walked in any other way than on the dorsum of the foot, which is at right angles to the inner side of the leg. They may or may not have been submitted to operation; but if they move about easily and well, and are satisfied with their condition, which has existed from birth, the question must arise whether they will not at such an age be better left as they are. This must be decided by the peculiarities of each case.

2. Congenital talipes calcaneo-valgus. *Pathological anatomy.*—Compared with equino-varus, this is rare as a congenital deformity. It varies also very much in the degree with which it presents itself as a malformation. The mildest form is that of calcaneus with slight eversion of the foot (Fig. 494), which is the normal

position during the latest period of intra-uterine life. In most babies the foot can be easily placed in this position, with the dorsum of the foot almost touching the front of the leg. But there is in such cases no real shortening of any of the tissues, so that the foot can be placed at will in any position. In extreme cases the foot is rigidly held by contracted muscles and ligaments, in a position exactly opposite to that of the equino-varus (Fig. 495). The whole foot is everted with the outer border raised and the inner side depressed. The tarsal bones are here separated from one another, and the head of the astragalus presents towards the sole of the foot instead of upon the dorsum.



Fig. 494. — Congenital Talipes Calcaneo-valgus. (St. Thomas's Hospital Museum.)

Treatment.—In the mild form of the deformity, in which the joints appear only to be abnormally loose, time will, as a rule, correct the deformity. The margins of the articulations will grow and limit these abnormal movements. If this is shown not to be the case, then some simple retentive apparatus is all that is necessary, and the simpler the better—such as a splint of moulded leather or poroplastic.

When the time comes for the child to struggle on its feet and the foot is seen to become everted from the weight of the body, some apparatus is essential. At a still older period of childhood, if this laxity of joint still exists, boots with thickened “uppers” or lateral irons should be worn, according to the severity of the deformity, and the ordinary child's slippers absolutely forbidden.

In the rigid and contracted variety of calcaneo - valgus, the treatment should be conducted on the same lines that have been already described under equino - varus. Manipulation, alternating with plaster of Paris

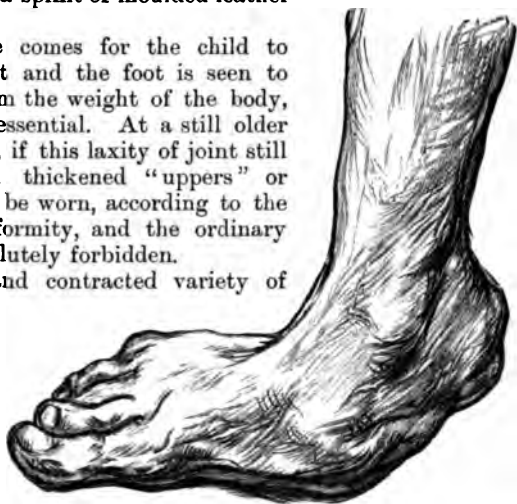


Fig. 495.—Congenital Talipes Calcaneo-valgus. (St. Thomas's Hospital Museum.)

applied to the foot in the corrected position, must for the first few months be most thoroughly carried out.

Operation.—It is only in exceptional cases that an operation becomes necessary, for, as a rule, manipulation and occasional

fixation in the correct position will cure the larger proportion. But if the foot cannot be inverted and extended in this way, the rigid structures must be divided. Under an anæsthetic, tendons and ligaments are subcutaneously divided each as they appear tense on attempting to correct the deformity. The peronei and extensors of the ankle joint are first to receive this attention. The external lateral ligament, especially the anterior fasciculus, will be sure to require division, and probably a part or the whole of the anterior ligament of the ankle joint must also be divided before the foot can be flexed and inverted. But the surgeon must not rest satisfied till he has fully corrected the deformity, when the foot can be placed in plaster of Paris for a month. After this, manipulation and massage may be resumed and continued till all rigidity has disappeared. When the time comes for walking a special boot may be required, but there is not the same tendency to relapse as in equino-varus if the treatment above described has been properly carried out.

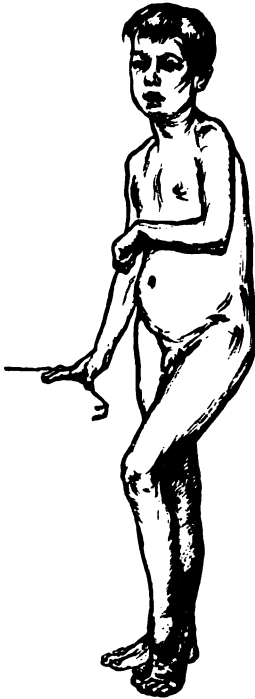


Fig. 496.—Talipes Equinus following infantile hemiplegia. From a patient, aged 8 years, under the writer's care (1893).

Acquired club-foot.—The acquired forms of talipes include: (1) the paralytic varieties, which are numerous; (2) those due to spasmodic contraction and eventual shortening of muscles; (3) talipes cavus; (4) flat foot.

(1) **Paralytic talipes.**—Infantile paralysis is the most common cause of acquired talipes in children. The foot may partially assume any one of the positions already described, according to the particular muscles affected. Talipes equinus is, however, by far the most common, for if the whole foot be paralysed, this is the posture of rest into which the part naturally falls. And if the patient be in bed at the time of the illness,

the bed-clothes would tend still further to depress the front of the foot towards the position of equinus.

The approximation of the origin and insertion of a muscle eventually leads to its shortening. Consequently, in whatever position the foot is drawn by its own weight, or by the action of unopposed muscles, it is eventually rigidly held by the absence of stretching, to which all muscles should be subjected for the maintenance of their full length.

If there is any inversion of the foot, it never assumes the degree of deformity seen in congenital equino-varus. The same may be said of the paralytic valgus and calcaneo-valgus, and if the

treatment is undertaken before much lapse of time, there is no shortening of ligaments or alteration of bones.

The diagnosis is made by the history of the onset, and the absence of any deformity at birth. The limb is colder than its fellow, there is a tendency to chilblains, and the bones are smaller than on the opposite side of the body. Hemiplegia must also be mentioned as a cause of this variety of talipes (Fig. 496).

Treatment.—If the foot cannot be placed in the normal position, the tendons which prevent such restoration must be subcutaneously divided. When this has been accomplished, and the bond of union is of sufficient strength, a boot and double irons, with a spring (Fig. 497) or rubber accumulator on the paralysed side, may enable the patient to walk. But if other muscles have been paralysed above, such as the extensors of the thigh and leg, a much more complicated apparatus may be necessary. The difficulty, as a rule, consists in obtaining sufficient stability in the knee and ankle joints. To obtain this result without amputating what appears to be a useless member, it is sometimes an advantage to produce ankylosis in one or both of these joints. The circumstances in which this becomes a feasible method of treatment are beyond the scope of this article. (See page 81.)

(2) **Talipes due to spasmodic contraction.**—Spasmodic contraction of muscle by adaptive shortening may lead to talipes, and nearly always to talipes equinus.

The best instance of this is the congenital spastic paraplegia, the pathology of which cannot be here discussed. It is a symmetrical affection of the lower limbs, not only causing the heels to be raised from the ground, but the knees are slightly flexed, and the thighs adducted. Subcutaneous tenotomy of the tendo Achillis may enable the patient to walk in a somewhat better manner, with the soles of the feet upon the ground. Other tendons above, both about the knee and hip, may also require division, and improve the gait; but these operations cannot cure the condition, which is dependent upon a disease or congenital imperfection of the central nervous system.

Another and very important variety of muscular rigidity, which eventually terminates in a mild form of talipes equinus, and is sometimes spoken of as "right-angled contraction of the tendo Achillis," is that which follows upon long-continued rest with



Fig. 497.—Ernst's Apparatus with Toe-elevating Spring for Paralysis of lower Extremity below the Knee Joint. The dotted line shows the position of the boot when the action of the spring is overcome by the weight of the body. The figure indicates the action of the spring.

the toes slightly pointing downwards. This degree of equinus rarely passes much beyond the right-angle (hence its name), and is consequently not always recognised as early as it should be. It commonly follows a fracture of the tibia, in which the foot has not been maintained in the splint at a right-angle with the leg;* and when the patient subsequently tries to walk, he cannot bring his heel easily to the ground. It should, of course, be prevented from occurring by proper attention to the position of the foot in applying the splint. When, however, the gastrocnemius is really shortened, and cannot be stretched by manipulation and massage,



Fig. 498.—Talipes Cavus. (St. Thomas's Hospital Museum.)

the tendo Achillis must be divided, and the foot placed in the fully corrected position in plaster of Paris.

(3) **Talipes cavus.**—Talipes cavus or "hollow foot" (Fig. 498) is treated here in a separate paragraph, as some difference of opinion exists as to its causation. The deformity consists of an abnormally high arch, with a corresponding increase in the convexity of the dorsum. The ball of the great toe is very prominent, and is liable to corns. The os calcis (Fig. 499) assumes a more or less vertical position, and in this way is approximated to the front part of the foot. The plantar fascia can be felt to be thickened

* The vertical foot-piece and wooden splint which Mr. Arbuthnot Lane has so rightly condemned is in part responsible for this, as it is more difficult to keep the foot at right angles when inverted than when it is allowed to fall into its natural everted position. (See Clinical Society's Transactions, vol. xxvi. p. 120; and *British Medical Journal*, 1893, vol. i. p. 1162.)

and contracted in the sole. The first or proximal phalanges of the toes, especially that of the big toe, are hyper-extended on the metatarsal bones, whilst the distal ones are flexed. The tendons of the extensor proprius pollicis, extensor longus digitorum, and tibialis anticus, can be felt and seen to be contracted.

This deformity is always associated with a certain amount of talipes equinus. These are the principal points which are worthy of notice in a case of talipes cavus. The question naturally arises as to its causation, so that the proper treatment may be adopted. Many different views have been held, but the most satisfactory explanation in my opinion is that advanced by Mr. Parkin.* He has endeavoured to show that the primary condition is one of slight talipes equinus, and that the direct result of the transmission of the weight of the body to a foot in the position of talipes equinus is a compensatory change, which tends to bring the heel to the ground.

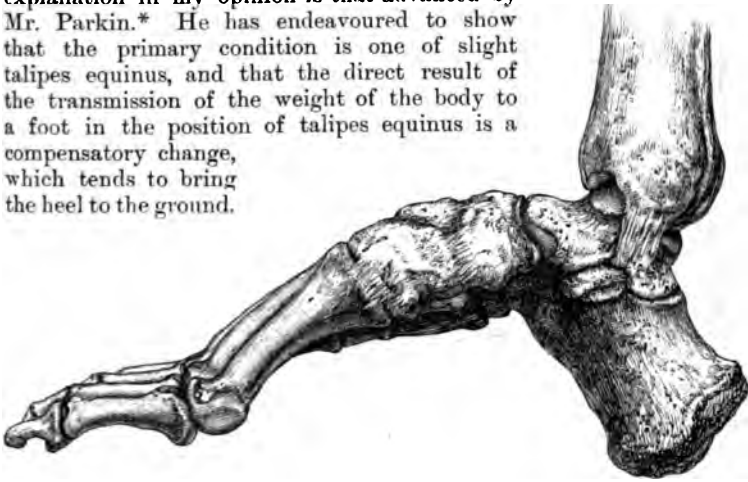


Fig. 490.—Talipes Cavus. (St. Thomas's Hospital Museum.)

The os calcis, therefore, assumes a somewhat vertical position, and the sole of the foot becomes arched. The plantar fascia shortens from approximation of its origin and insertion, and is not the primary cause of the deformity.

Treatment.—By the time the case comes under observation, the structural alteration of the tarsal arch is, as a rule, so confirmed that little can be done to cure the deformity. If when the knee is fully extended the foot cannot be brought beyond a right angle with the leg, the tendo Achillis should be divided. At the same time the plantar fascia may also be divided, so as to allow the bones to separate.

After two months' fixation in plaster of Paris, massage and manipulation should be ordered, and boots made with a depression in the sole for the ball of the big toe. The boots should not meet in front, and laces should be employed to try to keep the arch of the foot pressed down towards the waist of the boot, which should be particularly firm or even strengthened by a short steel plate

* *Medico-Chir. Trans.*, 1891, p. 485.

(4) **Flat foot.** *Causation.*—There is undoubtedly a predisposition to flat feet in “flabby,” weakly children who have long feet in proportion to their bodies. A short, firmly-knit, high-arched foot never becomes flat. This latter condition is associated with short, well-developed muscles; whereas flat feet are found in those whose limbs are long, and whose muscles are soft and flabby. This same muscular debility or relaxation is found in those who are liable to lateral curvature of the spine, and the two conditions are often met with in the same subject. Rickets often causes this atonic condition of the muscles; knock-knee, by altering the line of gravity, may also be the cause of flat feet.

Flat feet are generally first complained of about the age of puberty, especially in boys of the lower classes, where long-continued standing or walking has suddenly become a necessity in their occupation as errand boys. The feet are probably already flat, when their change of occupation from school makes evident the weak point in their structural organisation.

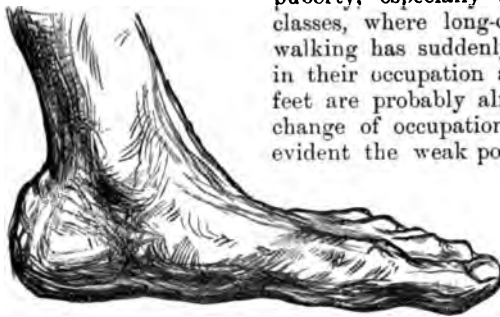


Fig. 509. — Flat Foot. (St. Thomas's Hospital Museum.)

At any age, after acute articular rheumatism and gonorrhœal rheumatism the feet may suddenly become “flat”

when the patient begins to walk. The ligaments have in these cases probably become softened by inflammatory exudation and the muscles weakened by long-continued rest. After a severe injury to the ankle the same result may follow. These instances are sometimes spoken of as “acute flat feet.” The term “traumatic flat foot” applies to those cases in which a fracture near the ankle has resulted in a displacement of the foot outwards.

Symptoms.—The gait of a person who is the victim of flat feet is fairly characteristic. A slight waddling movement is, perhaps, the most noticeable feature. They also lean a little forwards with the knees slightly bent, as they are unable to raise themselves on their toes in walking. Their toes are turned out, and their heels never leave the ground; in fact, all elasticity in walking has gone. The position of the whole foot is one of abduction.

Pain is often, but not always, a prominent symptom. At first it is generally situated about the calcaneo-cuboid articulation, and later along the inner border of the foot. The former is probably due to the crowding together of the bones on the outer side of the foot, and the latter from stretching of the fibrous tissues.

The feet are long and the toes turned out, with abduction in front of the medio-tarsal line, whilst the inner border is convex from the concavity of the arch being filled up with the sunken

scaphoid and head of astragalus ; the dorsum of the foot towards the outer border is depressed from the same cause (Fig. 500). In the early stage, if the patient is directed to raise himself on tip-toe, the foot is temporarily restored to its proper position by the action of the calf muscles. But in old and confirmed cases the patient is either quite unable to stand on tip-toe, or if he does so imperfectly the deformity is not corrected. The same difference is observed if the foot is taken in the hands of the surgeon and an attempt made to restore the arch by inverting the foot. In this movement the peronei may be found tense, their contraction being probably due to a long-continued approximation of their origins and insertion.



Fig. 501.—Extreme Flat Foot. From a patient, aged 20, a farm labourer, under the writer's care in 1888, and afterwards treated by Ogston's operation.

Pathological anatomy.—The arch of the foot is primarily supported by the three deep muscles of the calf with the tibialis anticus and the peroneus longus. The ligaments only secondarily help to keep the bones together, and prevent them from separating from one another. The most important of these are the calcaneo-scapoid and the internal lateral or deltoid ligaments of the ankle joint. The long and short plantar ligaments are also of considerable value. When the muscles have become weakened from any cause, these ligaments soon yield to the weight of the body. The head of the astragalus and the scaphoid are then found to be abnormally low, and in bad cases to be resting upon the ground while taking the weight of the body in the erect position. They may even be projecting into the sole, and form one of the points upon which the foot rests (Fig. 501).

In old and chronic cases the head and neck of the astragalus are so much altered in shape and position, and so locked by osteophytic

outgrowths around the astragalo-scapoid joint, that the arch could not possibly be restored without some method of resection.

The first metatarso-phalangeal joint is also often found to be rigid, swollen, and painful.

Treatment.—A. For a recent case of flat foot in which the arch can be easily restored:—

- (1) Systematic exercises to develop the muscles of the leg,



Fig. 502.—Whitman's Steel Brace. (Ernst.)



Fig. 503.—Whitman's Steel Brace applied.



Fig. 504.—Whitman's Steel Brace, showing outer lip or flange.

especially those of the calf, should be taught. Varieties of the "tiptoe" movement are the best for this purpose, especially those in which this exercise is practised with the feet inverted, i.e. with the toes pointed inwards and the heels wide apart. Massage of the deep muscles of the calf and sole of foot should also be employed for at least ten minutes each day. If much standing is necessary, the patient should be instructed to stand on the outer edge of the foot and boot, and to frequently raise himself on his toes.

- (2) Boots which "lace up" should be worn with straight inner borders, square toes, large heels of moderate thickness, and, above all, a strong "waist." The sole and heel may be thickened on the inner side by additional leather, so as to throw the weight to the outer side.

(3) If the occupation of the patient is one that necessitates very prolonged standing, with little or no relief by the exercise of walking, then Whitman's steel brace is likely to be most serviceable. The original description of this useful support will be found in the *New York Medical Journal*, 1892, p. 227. (See Figs. 502, 503, and 504.) A plaster-cast of the foot is taken in the position of adduction, with the arch in its normal position. A steel plate is then cut of the pattern shown in the figure, and hammered out to fit the cast. This is worn inside the boot. The lip on the outer side keeps the arch from sliding out towards the abducted position whilst the plate itself follows the irregularity peculiar to each foot.

B. For acute cases after rheumatism or gonorrhœa :—

(1) Rest in a plaster-of-Paris splint, till the ligaments are no longer liable to stretch, for a month at a time, is the first and most important line of treatment.

(2) Massage of the muscles of the calf, and manipulation of the ankle and foot, in the intervals between the periods of rest should also be adopted.

C. For cases accompanied by some fixation from contraction of the peronei and adhesions within the joints :—

(1) An anæsthetic should be given, and the foot inverted. If this is impossible, which is unusual, the tendons of the peronei may be subcutaneously divided.

(2) The foot, when thoroughly inverted, should be placed in plaster of Paris for a month.

(3) This should be followed by massage, manipulation, and tip-toe exercises.

(4) A boot should then be ordered of the kind described above, with the addition, in a severe case, of an outside iron and a T strap, so as to draw the foot inwards and throw the weight to the outer side.

In some cases of rigidity in which the foot is firmly held in the abducted position it can be restored without an anæsthetic by steady and firm pressure with the hands. If this can be accomplished, it should be done every day for a week, and the patient encouraged to move his foot in the same direction constantly whilst massage and other exercises are employed. If little or no progress is made in a few days or a week, the treatment should be conducted under an anæsthetic as described above.

D. For cases in which no improvement in the arch can be effected by manual force. (See Fig. 501.)

This condition is almost confined to hospital patients in whom early treatment has been neglected, or, for financial reasons, has been impossible. Pain is here the ruling feature, for the deformity cannot be corrected. If, by judicious treatment in the direction indicated above, no relief from constant pain is obtained, and the patient is almost unable to follow his occupation on this account, one or other of the operations that have been proposed by Ogston, Davy, Golding Bird, and Stokes should be adopted.

Ogston * removes the cartilaginous surfaces of astragalus and scaphoid, and procures ankylosis by ivory pegs.

Davy and Golding Bird † have excised the scaphoid. The latter has, in addition, performed tarsotomy, at the same time removing the scaphoid and a portion of the astragalus.

Stokes ‡ has removed a wedge of bone from the head and neck of the astragalus.

Genu valgum, or knock knee. Ætiology and pathological anatomy.—There are two classes of cases which have

* *Lancet*, vol. i., 1884, p. 153.

† *Lancet*, vol. i., 1889, pp. 675 and 677.

‡ *British Medical Journal*, vol. ii., 1894, p. 1224.

to be considered—one which is due almost certainly to rickets, and another which appears to be often independent of this disease. The first variety most commonly arises between the ages of two and four; but inasmuch as the changes in bone from rickets continue sometimes through adolescence, this disease must also in some cases be in part responsible for the later appearance of the deformity. The

second class arises, as a rule, at or about puberty, and is sometimes entirely independent of rickets, although, as we have just stated, the condition may occasionally be in part due to this disease.

1. *Rickets* (see p. 370, and Fig. 76, Vol. I.) gives rise to genu valgum in two ways—(i) The imperfect ossification of bone may allow the shaft of the femur to bend, either from the weight of the body in standing and walking, or from the sitting posture of the child upon the ground. The femur is curved forwards and outwards throughout its whole length. If this is continued into a corresponding curvature of the tibia, the condition known as “bow legs” results. But in genu valgum it is generally accompanied by a twist in the lower end of the femur with the convexity inwards. This is thought by some surgeons to be the commonest cause of knock-knee. (ii) Irregularity of growth at the epiphyseal line is one of the special features of the bone changes due to rickets. This may result in lengthening of the inner condyle, or merely in its depression below the level of the outer condyle by growth



Fig. 505. — Genu Valgum. From a patient, aged 14, under the writer's care (1893). He had had crooked legs as long as he could remember. There were seven inches between the malleoli. Osteotomy of both femora and tibiae was performed with good result.

on the diaphyseal side of the epiphysis. Or, on the other hand, premature ossification of the outer condyle may arrest its further growth. The outer condyle is then relatively smaller and less developed in the vertical direction than the inner condyle. Whichever of these two conditions is present the result, so far as the plane of the articular surface is concerned, is the same. The inner condyle is on a lower level than the outer, and the tibia is consequently thrown out of the line of the centre of gravity. The same irregularity of growth may take place at the epiphyseal line of the tibia, causing an elongation of the inner head of the tibia (Fig. 505).

If either or both of these bones is involved inversion of the knee is the result. It should be remembered that even normally the axes of the femur and the tibia do not exactly correspond; so that there is a tendency in the direction of this deformity from the natural structure of the limb. The weight being transmitted unequally from the condyles to the two heads of the tibia there is possibly a natural tendency towards inequality of the rate of growth: when once a deviation of the knee has begun the difference between the condyles in transmitting the weight of the body is increased. The part relieved from pressure is likely to grow faster than the opposite side of the same limb. The deformity, therefore, when once it has begun, tends to increase more or less rapidly.

2. Genu valgum in which there are *no obvious rickety changes* in the bones, is generally first seen about the age of puberty. Here it is probable that many conditions found in weakly subjects suffice to start the trouble; once it has started, inequality of pressure will do the rest. Flat foot and lateral curvature of spine are seen in the same subjects. The same muscular relaxation that occurs in these diseases will allow the strain at the knee to be thrown upon the internal lateral ligament. The centre of gravity from the hip joint falls outside the centre of the knee, so that there is natural tendency for the stress to be felt on the inner side. This is still more the case if there is flat foot with its consequent eversion. If the knee deviates to the slightest extent towards the inner side, almost all the weight will be transmitted through the outer condyle. Parts relieved from pressure will grow faster than those which bear the weight. The deformity, therefore, tends to increase. Exactly the same result is seen in the bodies of the vertebræ in an old-standing lateral curvature of the spine. The bodies are thicker on the convex side of the deformity where the pressure is less than on the opposite or concave side, where they are squeezed and crowded together. This class is sometimes described as the static variety of genu valgum.

Symptoms.—The condition is sufficiently obvious without any special description. Next to the presence of the deformity the most frequent complaint made by the parents is that the child is constantly falling. It will be seen, if the child is watched whilst walking and running, that the knees cross. They are, therefore, liable to knock against each other (knock knee) and cause a fall. This is best appreciated by stripping the child and watching these movements without the intervention of the clothing. Complaint is also constantly made in young boys and adolescents that their legs and knees ache at the end of the day.

Examination.—In the recumbent position with the limbs extended and the knees placed together and the patellæ looking forwards, it will be found that the ankles are separated from one another to an extent which varies according to the severity of the deformity. The distance between the two internal malleoli should always be measured, as it forms a ready means of comparison in

the progress of the case. The same result may be obtained by a tracing of the outline of the two limbs, from the knees to the ankles, on a large sheet of paper. Any measurement over one inch must be looked upon as a deformity, and require treatment. Three inches, as will be mentioned shortly, may be considered as a debatable point at which a decision must be made between one kind of treatment and another. Seven, eight, and nine inches' separation are not uncommon measurements to record amongst the children of the poor. If the knees are bent and placed together, it will be found that the ankles are no longer separated, the head of the tibia being behind the condyles of the femur. This fact is used as an argument in favour of the view that the deformity is due to a downward projection of the internal condyle. Whilst in this flexed position the line of articulation between the femur and the tibia should at the same time be felt and possibly marked with ink, so as accurately to estimate to what extent one or both bones are increased on the inner side. The feet should be carefully examined for any

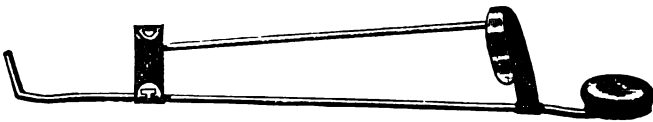


Fig. 506.—Thomas's Splint for Knock Knee. A bandage or handkerchief draws the knee outwards. There is no joint in the apparatus, and the patient walks with a stiff knee. (From Ashby and Wright's "Diseases of Children.")

abnormality, especially as to the condition of the arch. (See page 62.) For flat feet may predispose to the occurrence of knock knee, as in the case of a young adult, or it may be the sequel of this deformity in early rickets.

Treatment.—In a young and rickety child the general treatment for that disease should be adopted. When the deformity first appears and the bones are still soft, much improvement may be obtained without recourse to operation. Massage and manipulation—attempts at bending the bone with the hands—should be employed for a short time every day. In the intervals, Thomas's splint (Fig. 506) may be worn, and the child taken out into the fresh air as much as possible in a perambulator. Unfortunately, in the class of patients amongst whom these rickety deformities are so common, this line of treatment is almost impossible. Consequently the large majority eventually require operative interference. When the bone has become sclerosed (see Art. RICKETS, p. 371, Vol. I.), no improvement for many years can be expected without division. The period when the sclerosis may be considered to have taken place is when the deformity has existed without any alteration for more than a year, although the general health has improved. When the child has reached the age of about six years, the bone in favourable circumstances should be firmly ossified, although it is not uncommon to find it still soft. The amount of separation between the internal

malleoli has also to be considered. Three inches may be looked upon as the boundary line. A separation between the malleoli amounting to less than three inches, may possibly, other conditions being favourable, be corrected by time and non-operative treatment. But beyond this point success is not likely to be obtained, at any rate for so long a period as to make the operation highly desirable. This is especially the case amongst hospital patients.

Operation.—(1) *Osteotomy.* This is so simple and so accurate as to the exact position selected, and moreover so free from risk at the present day, that I have not adopted any other method of operation. Macewen's operation is undoubtedly the best method for the femur. The reader is referred to works on Operative Surgery for the details of his method. It must be remembered that the tibia may also require division immediately below its upper epiphyseal line before the deformity is fully corrected. This may be done at the same time as the femur; or if both femora are divided at one sitting, the division of the tibia may be left to another occasion when it will be seen how much more is necessary to bring the limb into a straight line. But, as a general rule, both femora and tibiæ should be operated on at the same time if the first fails to correct the deformity completely, as the simultaneous division of both bones prevents the "over-correction" of one bone which might otherwise take place. In healthy subjects I have frequently, in one operation, divided both femora and both tibiæ, fracturing the fibulæ with the hands. The best method of dividing the tibia is through an open wound across the axis of the limb, and with a saw. Immediate application of plaster of Paris is undoubtedly the most satisfactory plan of immobilising the limbs and maintaining the corrected position. (See page 76, Fig. 517.)

(2) *Osteoclasia.*—Many surgeons of repute speak very highly of this subcutaneous method of correcting the deformity. It is maintained that, with a good osteoclast, such as Grattan's, the bone can be accurately fractured at any given spot.

The treatment of genu valgum in the adolescent period of life is conducted on much the same lines. When rickets is present, and the deformity has existed for some years, osteotomy or osteoclasia should be at once recommended. In those cases in which rickets is not present, and the separation of the malleoli is below four inches, an apparatus may be worn, and the case reconsidered in six or twelve months' time. The best apparatus is Thomas's (see page 68), but the patient has to walk with a stiff knee. Double irons, with pelvic girdle and joints at the hip and knee, are more comfortable, but not so efficient in correcting the deformity. Flat feet must be treated in the way suggested on page 64.

Bow legs.—The deformity known as "bow legs" is well illustrated in the accompanying Fig. 507. It is usually produced by a general curvature forwards and outwards of both the femur and the tibia, and does not so frequently arise from irregularity of growth at the epiphyseal lines as in genu valgum. Possibly squatting on the

floor, with legs doubled under the body tailor-wise, when the child is too weak to stand from rickets and the bones are soft, has a good deal to do with the uniformity of the curvature in its origin. It is subsequently increased by the weight of the body in walking. At an older age it is not uncommon to find one limb affected with the genu valgum, and the other with genu extorsum, which is a bow leg with the centre of the curvature at the knee (Fig. 508).

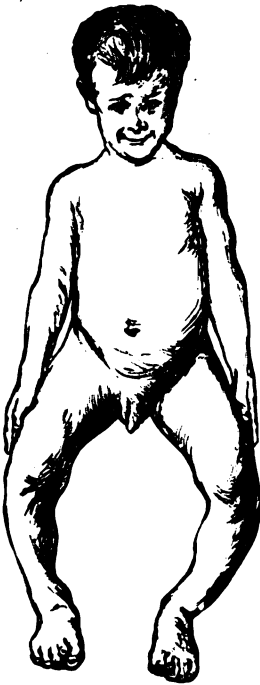


Fig. 507.—Bow Legs. From a patient with rickets, aged 4, under the writer's care in 1884. Osteotomy of both tibiae was performed with good result.

If the history can be relied upon, it will be found that the knock knee arose first. It is probable that the bow leg is the result of the knock knee on the opposite side, for the weight is thrown obliquely across to the other limb.

The treatment adopted should be of the same kind as that for genu valgum. Splints should be tried first with the force applied in the opposite direction. If this fails, osteotomy or osteoclasis of either femur or tibia, or of both, in the centre of the most prominent part of the curvature should be recommended.



Fig. 508.—Genu Valgum and Extorsum. From a patient with rickets, aged 14, under Mr. Pitts's care. (St. Thomas's Hosp. Reports, xiv.)

Other rickety deformities.—Other rickety deformities besides those already enumerated might be mentioned, but they are mostly varieties only of the same condition.

Curvature in the lower third of the tibia requires special mention, for it is sometimes seen in rickety children, without any other deformity of the lower limbs, but it is more frequently associated with knock knee and curved femora. It is not uncommon to find it in children who have never walked, and is thought, on that account, to be due to physiological causes. (See Article on RICKETS, p. 371, Vol. I.) It is always symmetrical. The convexity of the curvature in the

lower third of the tibia is directed forwards and outwards, and in this way overhangs the foot (Fig. 509). Many of these curvatures improve in the course of time without any local treatment, and, in any case, do not produce such bad results upon the rest of the limb as genu valgum or extrorsum.

They should not, therefore, be so quickly submitted to osteotomy, especially as the operation is not so simple a process as in the other class of deformity. If, however, the deformity has existed for a year or two without any material alteration, it is probable that a firm buttress of bone has formed in the concavity of the curve, which would forbid any improvement in the curvature, except from absorption on one side, and deposition on the other. This reconstruction of the normal axis of the tibia does undoubtedly take place in many cases, but not in all, and it must naturally take many years before nature has completed its work.

Osteotomy may be, therefore, recommended in selected cases. Most surgeons advise a wedge-shaped piece of bone to be removed (cuneiform osteotomy) from the most prominent part of the curvature. I have, however, obtained quite as good results from a simple division of bone. But forcible extension must be made, so as to create a gap in the concavity of the curve, which is eventually filled up with new bone. Accurate fixation in plaster of Paris whilst extension is being made will retain this position. After division of the tibia with the saw, the fibula can generally be broken; if not, it can be divided in the same way with the saw. The chisel should not be used, as the tibia is generally sclerosed, and requires too much force with the hammer, and the fibula being small, is too elastic for the efficient use of this instrument.

Tenotomy of the tendo Achillis is generally necessary to correct the deformity if simple section of the bone is done instead of a cuneiform osteotomy; without this relaxation sufficient separation of the fragments cannot always be obtained.

Rickety deformities of the upper extremity are comparatively rare, and still rarer are they sufficiently severe or persistent as to require any special treatment. An outward curvature in the lower third of the fore-arms is most frequently seen, and is always symmetrical.

I have never had occasion to do osteotomy, or to apply splints



Fig. 509.—Curvature in the lower third of the Tibia. From a patient, aged 7, under the writer's care.

for such a condition. The ætiology of this curvature is discussed in the Article on RICKETS, p. 370, Vol. I. Rickety curvature of the spine is also described in the same Article, p. 368.

Contracted and ankylosed joints. **Hip joint.**—Deformities of the hip joint from ankylosis, malposition, dislocation, and contraction may be considered in three fairly-well defined groups, arranged according to their ætiology. (See also p. 1097, Vol. I.)

(1) After tuberculous disease of the hip joint, in which all active changes have ceased and cicatrization has taken place, extreme flexion and adduction may produce a deformity which diminishes the usefulness of an otherwise serviceable limb, Figs. 510 and 512. (See also p. 1083, Vol. I.)

The absence of all swelling about the joint, its freedom from pain and tenderness, the presence perhaps of sound cicatrices, indicating the previous existence of discharging sinuses, would all show that the disease had ceased.

Examination of the joint in the manner indicated in Fig. 448 at p. 1085, Vol. I. (DISEASES OF JOINTS) would demonstrate the existence of lordosis and tilting of the pelvis, with partial or complete fixation of the joint.

If the head of the femur has been excised, it is unlikely to be more serious

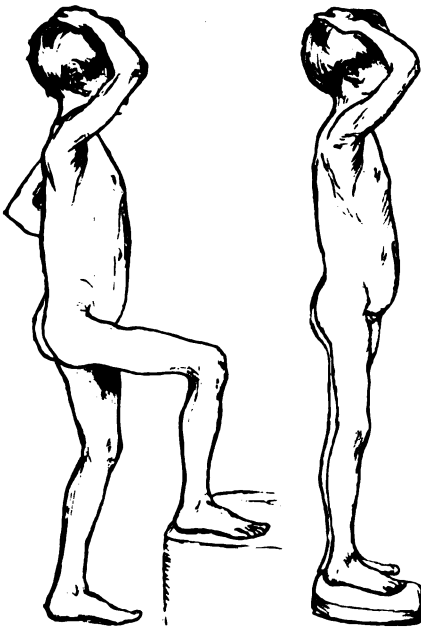


Fig. 510.—Ankylosis of the Hip at nearly a right-angle, after tuberculous Disease of the Hip. From a patient, aged 12, who had had disease of the hip nine years before.

Fig. 511.—Same Patient shown in Fig. 510, after osteotomy.

than contraction of the soft parts. An anæsthetic would at once settle this point, and if the limb can then be placed in a suitable position, a splint such as that depicted and described on page 76 would enable this to be maintained as long as it is thought desirable. This method of treatment may have to be repeated several times before a permanent result is obtained. An apparatus from a good surgical instrument maker is then desirable.

If under an anæsthetic ankylosis is proved to have been established and no movement can be obtained in the hip joint, the femur should be divided below the trochanter minor (Figs. 510 and 511). This is especially needful in cases in which the head of the femur

has not been excised, for any rough manipulation of an old disease of the hip joint is to be deprecated for obvious reasons, and an osteotomy below the lesser trochanter is free from the risk of starting afresh an old tuberculous lesion. The limb is after this operation retained in the best position by means of splints. (See Fig. 517.)

Figs. 512 and 513 illustrate a case in which there was extreme



Fig. 512.—Anchylrosis of the Hip in the adducted Position after tuberculous Disease. Showing tilting of the pelvis to bring the limbs parallel. (See also Fig. 514, A.)



Fig. 513.—Same Patient as in Fig. 512, showing the amount of Adduction necessary to bring the Pelvis to its normal Position. (See also Fig. 514, B.)

adduction of the thigh in a boy of seventeen after disease of the hip in infancy. Anchylrosis of the hip in the adducted position necessitated great tilting of the pelvis, to bring the limb parallel with the other in walking. (See also p. 1083, Vol. I., DISEASES OF JOINTS.) There appeared, therefore, to be three or four inches shortennig, but in reality the shortening was not more than half an inch. He was much improved by osteotomy below the trochanter minor. (See also Fig. 514, C.)

(2) In "chronic pyæmia" the joints are sometimes invaded by a
d *

slow and painless suppuration, and the head of the femur slips out through the capsule into almost any position round the hip joint. Fig. 515 illustrates a dorsal dislocation of this kind with extreme flexion and adduction of the thigh, which took place during puerperal fever. (See p. 1079, Vol. I.) The deformity was successfully rectified by osteotomy below the lesser trochanter. It is probable that in some cases excision of the head of the femur would produce as good a result where, as in this case, it was firmly fixed in its new position, but the operation is a much more severe one, and the patient is not likely to be in a satisfactory condition for

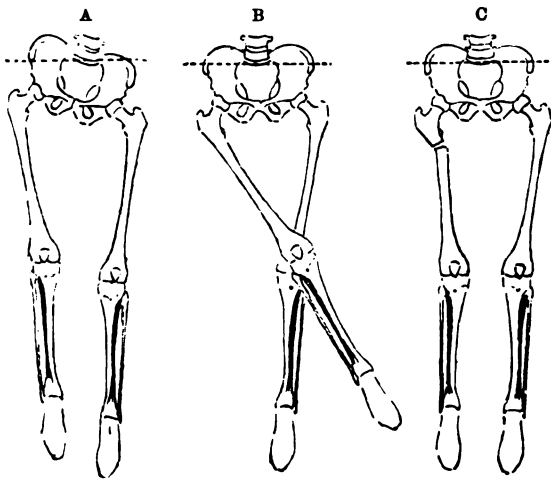


Fig. 514.—Diagram A, to explain Fig. 512; diagram B, to explain Fig. 513; diagram C, to explain the operation.

an extensive resection. I saw a case of dislocation of both hip joints from pyæmia under Mr. Pick's care at the Victoria Hospital for Children some years ago; on one side the head of the femur was on the dorsum ilii, and on the other in the obturator foramen.

(3) On three occasions I have seen both hip joints affected in the manner illustrated in Fig. 516, which was taken from a photograph. Both hip joints were ankylosed in an abducted position. In all three cases there was a history some years before of the patient being in bed for many months with what was called acute rheumatism. Gonorrhœa is undoubtedly the cause in many cases. The "spread eagle" position probably arises from its being the most easy posture in acute inflammation of the hip joint. It is also, it must be remembered, the position of the joint when distended with fluid. (See p. 1076, Vol. I.)

If on examination under an anæsthetic the joint be found ankylosed without any destruction of the bony surfaces, a condition

which is so commonly seen after tuberculous disease, the neck of the femur may be divided subcutaneously by Adams's saw. The

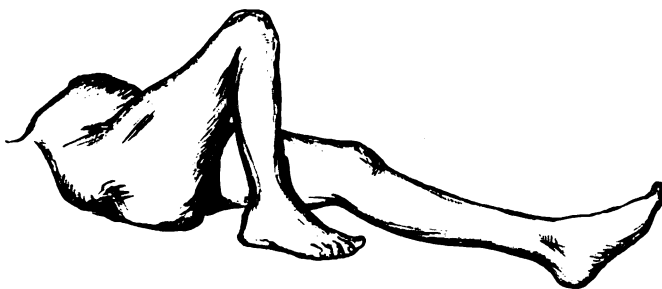


Fig. 515.—Dorsal Dislocation of the Hip after Puerperal Fever. From a woman, aged 34, who came under the writer's care a year after the occurrence. She was covered with scars from old bed-sores, and had a suppurating sinus in the right groin.

limb can in this way be brought straight, but experience shows that it is almost impossible by the most persistent efforts to obtain



Fig. 516.—Ankylosis of both Hips in the abducted position. From a patient, aged 41, who had been bedridden for six years after rheumatism.

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a movable false joint. If both hip joints are in this condition, the position can be rectified by osteotomy, but crutches will still be necessary for progression.

Other conditions external to the hip joint may produce deformity, *e.g.* after an old psoas abscess from caries of the spine, which has long since ceased discharging, the hip joint may be rigidly flexed from shortening of the psoas muscle and fibrous tissues. The hip joint will be found normal as regards its bony relations, and movable for further flexion, but cannot be fully extended. As a general rule, such a condition will yield to passive movement under an anæsthetic, and can then be retained in its improved position by carefully moulded plaster-of-Paris splints (Fig. 517). After a few weeks still further advance may be made towards complete extension by a repetition



Fig. 517. - Showing the Application of Plaster of Paris in Flannel Strips to the Trunk and lower Limbs, for a case of Contracted Right Hip, whilst extension is employed under an anæsthetic. The limbs are widely separated. Two light iron bars (A) connected by a rivet, are placed one over each groin between the layers of flannel, so as to ensure perfect immobility opposite the hip joint whilst the plaster is setting. These bars are shown at the right-hand corner of the figure. (From a photograph taken whilst the plaster was setting.)

of the same treatment. A deformity of the hip may also be produced by the contracting scar tissue following a severe burn. This must be treated on the lines indicated in the article on Diseases of Cicatrices, p. 229, Vol. I.

Knee joint.—Deformities of the knee joint are not so complicated as those of the hip. (*See also* p. 1112, Vol. I.)

(1) If tuberculous disease has been the original cause of the distortion the tibia will generally be found displaced outwards and backwards. It is also rotated outwards on the femur, and accompanied by a variable amount of flexion at the knee joint (Fig. 518). Excision of the knee joint would in most cases produce the most satisfactory result. But if from any special reason this treatment cannot be adopted an apparatus may enable the patient to walk with greater comfort. The disease must, however, have entirely ceased for this to be recommended. It is also not uncommon to see, ten years after an excision in childhood, a purely angular deformity with perfect bony ankylosis. The history shows that for some years the knee remained perfectly straight, and then, somewhere between the ages of twelve and sixteen, anterior angular distortion began to make its appearance and to increase steadily. Perfect fusion of the two bones will be found to have taken place. The deformity is due to a greater growth in length of the limb from the anterior part of the epiphysis of the femur. The lower epiphysis of this bone is normally prolonged upwards on the anterior aspect to include the whole of the articular surfaces of the condyles. In an excision of the knee joint, especially in those done some years ago, a transverse section of the femur with the saw removes more of the epiphysis from the back than from the front of the condyles, even when the operation is done in the most orthodox fashion. Consequently, in the growing epiphysis more bone is produced in front than behind the central vertical axis of the shaft. This angular deformity after excision of the knee in early childhood is another and powerful argument, if such were needed, in favour of the modern arthrectomy.

The *treatment* for lateral and angular displacement of the knee following upon tuberculous disease, whether an operation by excision or arthrectomy had been previously done or not, is the same. A wedge-shaped piece of bone should be removed from the convexity of the curvature. A simple osteotomy of the femur above such a deformity is rarely satisfactory, and in many cases where there is a deviation at the joint line, so that the femur and tibia are



Fig. 518.—Bony Ankylosis of Knee at a right-angle in a girl of twelve, after tuberculous disease.

partially displaced from one another, some apparatus would be necessary to give stability to this part of the limb, whereas an operation through the joint on modern lines entails no great risk if the original disease has ceased, and procures ankylosis of the two bones in the best possible position.

(2) Suppuration of the knee joint from pyogenic organisms, in whatever manner they are introduced (p. 1040, Vol. I.), may result in simple flexion of the knee joint, which can be corrected under an anæsthetic, and placed in the best position in some fixed apparatus. It is rarely possible, if suppuration has occurred, to be able to re-establish much movement. If it is thought desirable to make an attempt in this direction the splint should be removed when the inflammation has ceased, and massage and shampooing, with active and passive movements, at once begun. If the ligaments and cartilages have not been destroyed, it is astonishing sometimes to see in the course of six months how much movement is re-established by the patient's unaided efforts. It is, however, common in suppuration of the knee, if long continued, for the ligaments to be softened and to stretch. Consequently, the articular surfaces are not likely to be in a perfectly normal apposition. If the joint has been hopelessly disorganised with displacement and fixation in an abnormal position nothing less than excision will be of any practical utility. I recently excised both knee joints, which were displaced outwards and backwards, with extreme flexion, after suppurative arthritis following scarlet fever. The patient can now walk, an advantage one could not possibly have obtained in any other way. But, on the other hand, if the position be one in which the patient is able to make fair use of the limb, although the knee be ankylosed, no special treatment will be required.

(3) Deformity of the knee after acute rheumatism and gonorrhœa takes the form of flexion with more or less fixity, and finally ankylosis. The bones are not, as a rule, displaced from one another. The limb must be straightened under an anæsthetic if it be possible, and an effort made to establish a movable articulation. If this fails, as it often does, care must be taken to see that the joint ankyloses in a perfectly straight position. Excision may occasionally be necessary from the joint having been left too long in its flexed position, and must always be done if the limb cannot be brought straight enough to bear the weight of the body, provided the patient be in a satisfactory condition of health.

Ankle joint.—Deformities of the ankle joint following the diseases that have been mentioned above are nearly always in one direction. Owing to the difficulty in keeping the foot at right-angles in any splint, except plaster of Paris, or to carelessness during convalescence, a condition of acquired talipes equinus may be produced. If seen sufficiently early, the position may be forcibly rectified under an anæsthetic, but care must be taken that the foot is brought well beyond the right angle. If this cannot be done, the tendo Achillis must be divided. The foot is then placed in plaster of

Paris for a few weeks to ensure the proper amount of stretching, when massage and manipulation must be practised. If the tendon has been divided, six months will elapse before much weight can be borne by the foot. Meanwhile, some retentive apparatus must be worn. If the deformity cannot be rectified by manipulation under an anæsthetic or by tenotomy, and the foot brought to a right-angle, tarsectomy may be considered, provided the patient and the foot are in a suitable condition for such an operation; otherwise a boot with a high heel will have to be provided.

Lateral deviation of the ankle joint from irregularity of growth at the epiphyseal line of the tibia after tuberculous arthritis has been very successfully treated in the writer's practice by an osteotomy of the tibia just above the ankle joint. The reason for selecting this position is the same as that given for the corresponding disease in the hip.

Acute flat foot after rheumatism has been already described. (See page 62.)

Shoulder joint.—Contracted joints in the upper extremity are similar in kind to those already considered, but may be more shortly described, as movement is the principal point aimed at, and not stability. (See also p. 1124, Vol. I.)

In the shoulder, if stiffness be the only complaint, and the bones are in their proper relation to one another, manipulation under an anæsthetic may be tried, and followed by massage and passive movements. But if the history shows that it is a case of former tuberculosis of joint, great care must be taken not to start the disease afresh by tearing apart the adhesions which nature has produced in its conservative process of cure. A little at a time will be the safest method, if there be any doubt on this point. Dry caries of the head of the humerus will give the greatest difficulty in diagnosis.

Most frequently we must be content with very limited movements after this disease, and be thankful even for that. If the head of the humerus is in an abnormal situation after tuberculosis of this joint, it will probably be small and atrophied, and may be left alone. If, however, it is causing pain by pressure on nerves, a small portion might be excised. After suppuration, when all active changes have subsided, much more active treatment may be carried out; and if massage and passive movements, with or without anæsthesia, have failed in obtaining a movable articulation, excision of the head of the humerus should be performed. Removal of the articular surface at the anatomical neck will probably in all cases be sufficient. If the head of the bone has already been displaced during the suppurative process, the treatment to establish a movable shoulder should be commenced by the removal of the articular surface of the head of the humerus.

After rheumatic and gonorrhœal affections it is rarely possible to carry out any active treatment. The liability to relapse, and the fact that movement only of the articulation is the point aimed at, forbids much interference with the joint. In the lower extremity,

it will be remembered, the operations were countenanced only to enable the limb to carry weight, not to establish movement.

Elbow joint.—In the elbow joint, position as well as movement has to be taken into consideration. If the elbow cannot be flexed to a right-angle, the patient suffers in most cases from a serious inconvenience. For a labourer, however, who uses pick and shovel the open angle is sometimes more important for this purpose than the more flexed position in which the hand is brought easily to the mouth. The nature of the patient's occupation, then, must decide whether the angle at which the joint is fixed by previous disease is the most convenient one. Examination under an anæsthetic will decide whether the elbow can be safely forced into the position that is required. It must be borne in mind that the tip of the olecranon is easily torn off. It is rarely possible to re-establish the movements that have been lost; but in cases other than the tubercular, as has been pointed out in the joints that have been already described, it may be tried for a time.

Excision of this joint yields most satisfactory results, so far as movement is concerned; but it diminishes its strength for a working man. A movable elbow joint is so important in many occupations that excision must always be carefully considered in every kind of deformity of this articulation in which its usefulness is impaired by ankylosis in a false position. In old injuries, in which it is difficult to say exactly what has occurred, and in deformities from disease which has long since past, it is equally applicable. In some instances in which the outlines of the joint appear to be normal, with the exception of the head of the radius, there is impairment of movement only in the direction of full flexion. The removal of the head of the radius will overcome this difficulty without in any way impairing the other functions of this joint. (*See also p. 1129, Vol. I.*)

Wrist joint.—In the case of the wrist joint it is rare for any deformity to arise except that of ankylosis, with slight flexion. It is, however, common to find grave impairment of the usefulness of the hand by fixation of the tendons of the fingers to their sheaths. When this is fully established by long-continued inflammation, such as that following a whitlow or prolonged rest and disuse after Colles's fracture, the most painstaking efforts must be made by massage and manipulation to restore in some measure their mobility. Complete success is, however, not often attained.

Contraction left by infantile paralysis.—The most common deformity caused by contraction after infantile paralysis, is that which has already been described under Acquired Talipes (page 58).

Flexion of the knee may also be caused in a similar manner, for the rectus, vasti, and adductors are more often paralysed than the hamstrings. It becomes permanent by secondary shortening of the unopposed hamstrings. If the thigh can be flexed on the abdomen by the psoas and iliacus, the hamstrings may be divided subcutaneously, or by an aseptic open incision in the popliteal space, and the knee subsequently fixed by a suitable apparatus.

"Arthrodesis" is a name given to the operation for procuring artificial ankylosis of a flail-like joint, and is suitable for a certain small proportion of these cases. The articular cartilages are pared away and the bones fixed together by ivory pegs, which are much more satisfactory for this purpose than wire sutures. The synovial membrane need not be disturbed. If the parts below the knee are not paralysed and are sufficiently strong, the knee may be ankylosed in this way. It will do away with the necessity of any instrumental support, provided the foot is not in any way paralytic. If the extensors of the foot are paralysed, the ankle joint may be similarly treated; and in rare instances both knee and ankle joints may be ankylosed if the limb is likely to be strong enough to bear weight after operation. If the thigh, leg, and foot are completely paralysed, an amputation close to the knee joint would be the better treatment. If the muscles of the hip joint are paralysed, an amputation would be of little service except for the removal of a useless limb.

Hallux valgus. Morbid anatomy.

—In this deformity the big toe is abducted at the metatarso-phalangeal joint, the distal phalanx passing over or under the second toe (Fig. 519). The prominence at the inner border of the foot which produces so much distress, is caused by the head of the first metatarsal bone, which is enlarged by osteophytic outgrowths around the joint. The pressure against the boot invariably gives rise to a bunion or bursa between the bone and the skin, which is frequently inflamed and causes much pain and consequent lameness. The toes are also crowded together and liable to corns.



Fig. 519.—Hallux Valgus. (St. Thomas's Hospital Museum.)

There is little doubt that chronic osteo-arthritis is present in this articulation, either as a cause of, or as a sequel to, the deformity, which is always more or less symmetrical. Short boots are thought sometimes to be responsible for its origin in early life. But, on the other hand, cases may be seen amongst young subjects with very little deviation from the straight line, and a considerable amount of bony enlargement. And in some of these great care has been taken with the boots from the first, and yet the deformity steadily progresses, and in time assumes the condition shown in Fig. 519.

Treatment.—In early life, before the deformity has reached the permanent condition shown in Fig. 519, much can be done by attention to the foot covering. Boots should be ordered with a

straight inner margin and broad toes. Under the sock and next the skin, or over a digitated sock, a toecap can be worn, with an elastic band round the heel, which keeps the toe in a straight line. At night an apparatus should be applied which fixes the toe in this position. This should be made by an instrument maker.

If the toe is rigidly held in the abducted position, and the patient is quite young, the joint may be first wrenched into position under an anæsthetic, or the rigid structures divided by a tenotome, and fixed in plaster of Paris for a month. But I have seen little permanent good result from this treatment, and prefer to proceed at once to one or other of the following methods:—

(1) Excision of the articular surface of the head of the metatarsal bone, and as much of the osteophytic outgrowth as will reduce the enlargement on the inner border to normal proportions, is certainly one of the simplest and most satisfactory methods of permanently dealing with this deformity. It is not desirable to excise more than the articular surface of the metatarsal bone; the sesamoid bones should certainly be left intact. If more bone has to be removed to relieve the tension in this articulation, it should be taken from the base of the proximal phalanx. A movable joint may be subsequently established, but if it seems likely to ankylose, care must be taken to see that it is fixed in the best possible position. (See next paragraph).

(2) I have produced immediate ankylosis of this joint on several occasions, with a satisfactory result.

An incision is made in the axis of the toe on the inner side of the articulation, the bursa excised, the excessive bony growths reduced with cutting bone-forceps, and the cartilages of the joint shaved off with a gouge. An ivory peg is then driven from the phalanx into the head of the metatarsal bone, so as to fix it permanently in the desired position.* The phalanx should not only be held in a straight line with the inner border of the metatarsal bone, but it should be made to assume a position of slight dorsal flexion, so as to give a rounded contour to the base of the big toe. If this is overdone it will be pressed upon by the boot.

Hallux flexus and rigidus.—Fig. 520 is taken from an old cast in the museum of St. Thomas's Hospital, and shows very well the special feature of this deformity in its most aggravated form.

In a slight degree it is present in many cases of flat feet (see Fig. 501), and is then often spoken of as hallux rigidus. But this fixed condition of the toe, in which extension is impossible, is frequently seen without flat foot.

It will generally be found that the joint is painful, and is held in this position by the short flexor muscles of the big toe, and in time by adaptive shortening of the lateral ligaments. (See Hammer Toe, page 83.) Makins thinks that this is due to a peri-articular inflammation, which glues the extensor tendons to the bone, but allows the short

* St. Thomas's Hospital Reports, vol. xxii.

flexor tendons, which are farther from the joint, to escape. Makins* also agrees with Davies-Colley† in attributing the deformity, in most cases, to short boots and stiff "uppers."

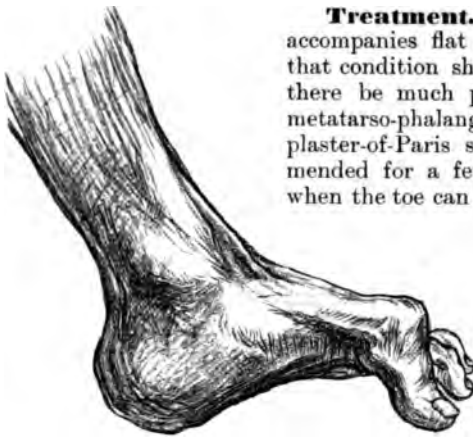


Fig. 520.—Hallux Flexus.

Treatment.—When hallux rigidus accompanies flat foot, the treatment for that condition should be adopted, but if there be much pain and rigidity in the metatarso-phalangeal joint, rest in a plaster-of-Paris splint should be recommended for a few weeks. In all cases when the toe can be restored to its proper position by manipulation, rest in a splint till all tenderness has subsided would appear to be the most rational treatment. Boots should then be ordered with stiff soles, broad and roomy toes, and soft "uppers,"

whilst exercises and passive manipulation should be encouraged. For severe cases, in which the deformity cannot be reduced by manipulation, or where the above treatment has been carried out and relapse has occurred, excision of some portion of the articulation should be recommended.

Removal of the articular surface of the head of the metatarsal bone would appear to be the best method, leaving the sesamoid bones undisturbed. Davies-Colley, in the paper before alluded to, has obtained excellent results by removing the base of the proximal phalanx.

Hammer toe.—Fig. 521 is taken from a patient who was under the care of Sir Wm. MacCormac. It shows very well the way in which the proximal phalangeal joint presses against the boot; the toe is flexed at this joint and cannot voluntarily be extended; a corn develops on the summit of this projection, and is the cause of endless pain and inconvenience in walking. Another corn is also often found at the extremity of this toe, where it presses against the sole of the boot. It is not often that patients apply to



Fig. 521.—Hammer Toes. In each foot the second toe is affected.

* Makins, *St. Thomas's Hospital Reports*, vol. xvii. p. 39.

† Davies-Colley, *Clinical Society's Transactions*, vol. xx. p. 165

the surgeon before these corns have drawn their attention to the condition; but it is probable that the deformity has usually existed for a long time before this takes place. In fact, many patients are able to state that they have known that this has been the case; the age at which such relief is sought is generally during adolescence. It is therefore fair to assume that the trouble nearly always commences during childhood. In some cases there is a distinct hereditary predisposition, and it is also generally symmetrical. Probably, therefore, an anatomical peculiarity is in part the cause of the condition, and this peculiarity would appear to be that this toe (the second) is too long and projects up to or beyond the level of the big toe. The ordinary boot supplied to fast-growing children would then complete the deformity, for the foot quickly outgrows the boot, which then presses back the toes.

Pathological anatomy.—The second toe is the one usually affected, but it is also occasionally seen in the other small toes;



Fig. 522.—Hammer Toe. On the left is a longitudinal section, showing the glenoid ligament below the joint; on the right the specimen has not been dissected. (Mr. Anderson's drawing.)

the proximal phalangeal joint is flexed and the distal one hyper-extended. The permanent flexion of the proximal joint has been proved by Shattock's dissection* to be due to shortening of the lower fibres of the lateral ligaments. He states that in the normal toe it will be found "that in the movement of flexion the lower fibres of the lateral ligament are relaxed, whilst the upper become tense, and that in extension the lower fibres become tense, the upper, on the contrary, becoming relaxed." If, therefore, from any cause the toe is retained in a flexed position, as, for example, crowding in too short a boot, the lower fibres of this ligament will become shortened from adaptive atrophy.

Wm. Anderson† has also independently made the same dissection and practically arrived at the same conclusion.

Fig. 522 is copied from Anderson's interesting paper which was illustrated by his own drawings.

Treatment.—Amputation of the offending toe, which was the routine treatment adopted by most surgeons, should be entirely given up. It is liable to be followed by hallux valgus from want of

* Path. Soc. Trans., vol. xxxviii., 1887, p. 449.

† Clin. Soc. Trans., vol. xx., 1887, p. 194, and Plate V.

lateral support to the big toe. As long ago as 1874 I have seen Sir Wm. MacCormac adopt excision of the proximal phalangeal joint as the most satisfactory way of dealing with this deformity; it does not seem to be of much moment which part of the articulation is removed. As long as enough bone is taken away to bring the toe into a straight line, a satisfactory result will be obtained. A narrow strip of guttapercha within the dressing will maintain the toe in the desired position till union of the two bones has been obtained.

Milder methods of treatment, such as the subcutaneous division of the ligaments, are very unsatisfactory, and entail such a long period of some retentive apparatus, and a further risk of relapse and subsequent operation, that it would seem best to proceed at once to excision. It is true that we see cases in which the toe can be straightened by the hand—i.e. before the deformity becomes confirmed. Still, even in these instances, excision will be found to be the most satisfactory, as the operation is free from risk, the result permanent, and the whole treatment over in a few weeks.

Supernumerary digits.—This congenital deformity is seen both in the hands and feet, and is often hereditary. It occurs most frequently in the hands, especially about the thumb and little finger, and is often symmetrical (Fig. 523). A small tag or fold of skin, with or without a little bone in its centre, may be the representative of this condition, and require only a pair of scissors for its removal. On the other hand, there may be a complete digit with its separate phalanges articulating with a common metacarpal bone. The latter may be of ordinary size, or nearly double its natural thickness, as if from fusion of two metacarpals; or there may indeed be absolutely two metacarpal bones side by side.

The removal of the extra member must under these conditions be conducted with the ordinary care of modern asepticism. If this



Fig. 523.—Left Hand, in which there is a supernumerary thumb and a supernumerary little finger. The middle finger is also partially cleft. (From a photograph in St. Thomas's Hospital Museum.)



Fig. 524.—Congenital Constrictions and Webbed Toes.

is done, there is no reason why the hand or foot should not be fashioned into the ordinary size and shape.

Webbed fingers and toes.—This, like the preceding deformity, is often hereditary. The breadth and thickness of each web, and the number of fingers and toes involved, may vary considerably. In a case under my care none of the digits of either hands or feet were separated from one another, although they were obviously all perfectly formed as regards their bones. In most instances two fingers or two toes (*see* Fig. 524) are connected together by a thick web so as to make them appear as one, or they are united by a comparatively thin fold of skin. In the foot no operation is required; but in the hand operative treatment may be desirable, either for increased usefulness of the hand or for the sake of appearances. If the web is so thick as to make

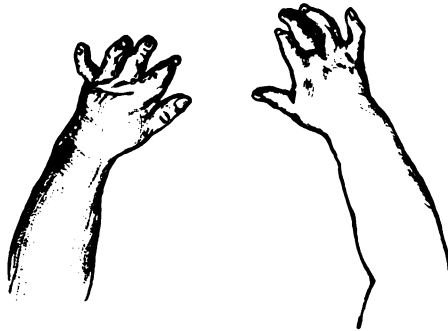


Fig. 525.—Congenital Constrictions and Webbed Fingers in the same patient as Fig. 524.

the two fingers appear as one, it is doubtful if an operation will in any way increase the usefulness of the hand. With a thin fold of skin a better result may be obtained. A simple division of skin is useless, as union gradually creeps up again along the line of separation. A plastic operation, such as those known by the names of Diday and Zeller, must be studied in treatises on Operative Surgery.

Congenital constrictions.—Figs. 524 and 525 illustrate a condition which is comparatively rare, and often associated with other deformities. In this case, which was under my care, there was a congenital constriction in the middle of the left leg, which seemed almost to reach the bone. The big toe of the same limb was represented by a stump, as if it had been removed by amputation. Both conditions are thought to be caused by amniotic bands—in the one case producing an indentation of the soft parts, whilst in the other it has arrested the development of the toe or removed it by strangulation. The latter is sometimes spoken of as “intra-uterine amputation.”

In the right foot of the same case it will be noticed that some of the toes are apparently fused or united by a thick web. The second

and third toes are thus united, whilst the fourth and fifth toes are in a similar condition.

The hands (Fig. 525) of the same patient were also remarkable.



Fig. 526.—Giant Toe. (St. Thomas's Hospital Museum.)

A similar constriction is seen round the proximal phalanx of the second finger of the right hand, whilst in both hands the index-finger terminates in a pointed extremity with a constriction at its base. The latter suggests that the hand was nearly, but not quite, sufficiently tight to remove the tip of this

finger. In the left hand the first, second, and third fingers were united at their bases by a broad, loose web.

Attached and parasitic fœtus.—Monsters of endless variety are occasionally seen, and are sometimes spoken of in the manner indicated at the heading of this paragraph. They are probably dependent upon duplication in part of the embryonic area, or the presence of two primitive streaks, which may remain distinct or partly fuse. The medullary groove may be double throughout, or in some particular part; or the duplication may occur still later, in which case it is probably limited to parts which are lateral. If the cleavage has taken place in the earlier stage, and been complete, twins would result; but where this cleavage and duplication is imperfect, the second, or attached fœtus appears as a "parasite," and is dependent entirely on the fully-developed fœtus to which it is attached. It is impossible in this article to enumerate, much less describe, the varieties of this malformation.

The teratomata, which are tumours made up of a great variety of different tissues, and are thus distinguished from ordinary new growths, are thought to be of this nature.



Fig. 527.—Fœtus in which all four extremities are wanting. (St. Thomas's Hospital Museum. No. 2624.)

They are remnants of parasitic or attached fœtuses which have failed to develop. Some of the congenital sacral tumours are teratomata, containing bones, portions of organs, etc. Others are included within the body of the host, and are so completely overgrown by the tissues of the autosite as not to appear externally.

Congenital hypertrophy (giant fingers and toes).—

The ætiology of this condition is not known. It is not, as a rule, hereditary. The effect of so-called "maternal impression,"



Fig. 528.—Congenital Absence of left Fibula. From a girl, aged 5, under the writer's care.

although popularly supposed to have some ill-defined influence, is purely speculative.

It is not often seen at birth, and therefore, although it is probably congenital in origin, the name is somewhat misleading. In most cases the deformity has been first noticed in infancy or childhood, and has remained stationary for some time, and then suddenly assumed more or less gigantic proportions.

It is nearly always unilateral, and scarcely ever affects more than a portion of one limb, such as one or more toes or fingers (Fig. 526). Hence the term "giant toes and fingers."

Some irregular enlargement may occur above this, but it is always most fully developed at the more distal part of the limb. The bones of the part involved are large, but the most noticeable feature is the frequent association of this condition with an irregular development of fat in lumps and masses, and the presence in many cases of angiomas both of the blood-vessels



Fig. 529.—Congenital Absence of the right Tibia, the Foot articulating with the side of the Fibula. From a patient, aged 17, under the writer's care.

and the lymphatics. The arteries themselves are not enlarged, but the condition appears to resemble most nearly the veno-capillary nævus and lymphangiectasis.

Treatment.—In most cases an amputation of the part involved would be advisable ; but if the amputation would mean the sacrifice of the greater part of a limb which, although deformed, serves some useful purpose, it had better be left alone.

Congenital deficiency.—One or more limbs may be entirely suppressed, or represented only by a rudimentary hand or foot.

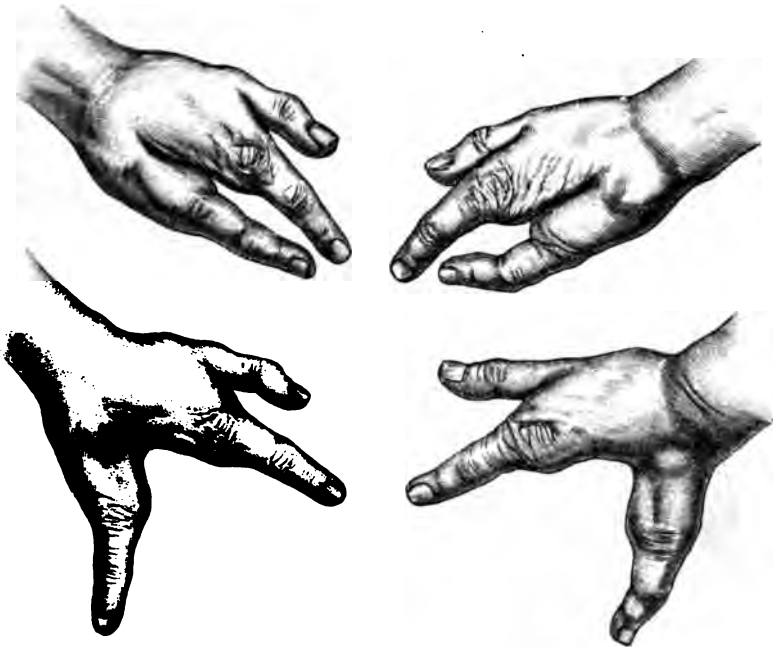


Fig. 530.—Absence of two middle Fingers in each Hand. The third metacarpal was fused with the second, and the fourth with the fifth, allowing the wide separation shown in the drawings. From the photograph of a boy, aged 13, who earned his living as an organ-grinder. No history in his family of deformity.

Fig. 527 represents a specimen in which all four limbs are absent, whilst the shoulder and pelvic girdles are perfectly formed. But some of the most interesting cases are those in which the limb is present, but one or other bone is deficient. In the upper limb the radius* is sometimes absent, as shown in Figs. 488 and 489, pages 50 and 51. The hand then assumes the position known as "club hand," and articulates with the lateral aspect of the ulna. In such cases the thumb is generally absent or rudimentary.

* See a valuable paper by Mr. Shattock, Path. Soc. Trans., vol. xxxiii., 1882, p. 240, in which four specimens are described. Parker also, in the same volume (p. 236) describes and illustrates two living cases.



Fig. 531.—Fusion of Radius and Ulna in their upper thirds. It was symmetrical, and, therefore, probably congenital. (From St. Thomas's Hospital Museum, Nos. 2677 and 2678.)

midway between pronation and supination.

Genu recurvatum.—The knee in this deformity is hyperextended on the thigh, so that the angle it naturally forms

In the lower limb the fibula may be absent, as in Fig. 528, with the result that the foot is displaced outwards, and requires instrumental support to keep it in its normal position.*

Some of the outer toes and tarsal bones may in such a case be absent.

Absence of the tibia is much rarer than the above, but is well illustrated in Fig. 529. This youth has the proper number of toes, but the big toe and its corresponding metatarsal bone are small. There is a supernumerary little finger on the left hand. Mr. Bland Sutton† records a similar case, with an illustration and a description of the dissected specimen.

Absence of two fingers on each hand is seen in the accompanying illustration (Fig. 530), taken from a boy, who also was without a tibia, and presented the same appearance in the lower limbs as in Fig. 529.

The same deformity is also recorded without any other malformation. Parker and Robinson‡ give an excellent description of such a case, with a good family history of the same through several generations.

Fusion of two bones may also occur, as is seen in Fig. 531, which is taken from a specimen in which the radius and ulna were in both fore-arms united in their upper thirds by a bridge of bone. The fore-arm was fixed



Fig. 532.—Genu recurvatum. (From St. Thomas's Hospital Museum, No. 2731, and Path. Soc. Trans., vol. xlii. plate 6.)

* A similar case is recorded by Gould (Path. Soc. Trans., vol. xxxii. p. 152) with an illustration; also by L. A. Dunn (Ibid., vol. xl. p. 272); and by Targett (Ibid., vol. xliii. p. 126).

† Path. Soc. Trans., vol. xliii. p. 124.

‡ Clin. Soc. Trans., vol. xx. p. 181.

presents backwards instead of forwards; malposition in utero probably accounts for this condition.* The normal "packing" of the foetus should involve flexion of the knees. But in this case the lower limbs are found hyperextended along the ventral surface of the body, with the feet under the chin. This is one of the best arguments in favour of the mechanical origin of congenital talipes and other allied deformities—namely, malposition in utero—for in this case there is little doubt that this is the correct view of its origin (Figs. 532 and 533).

It may be present in one or in both knees, and be of slight severity or an extreme deformity. In the latter case, when the limbs are brought straight, there may be so much rotation that the heels look forwards and the toes backwards.

Treatment.—If an effort be made quite early to bend the knee in the proper direction, a decided improvement will probably be obtained. Chloroform manipulation and plaster of Paris will probably yield the best results. This should be repeated till full flexion is produced. Subcutaneous division of the capsule of the joint may be necessary, and experience shows that the front parts of the lateral ligaments are the most resisting structures. In my practice the result of treatment, commenced at a late period, such as at eight to twelve years, has been very disheartening, probably on account of an alteration in the articulating surfaces.

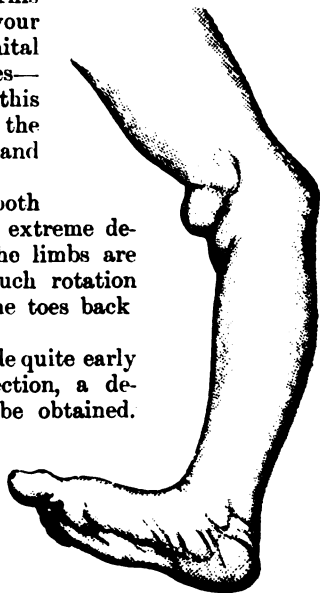


Fig. 533.—Genu recurvatum. A case of Mr. Pitts's, recorded in the paper by Mr. Shattock. A unilateral deformity in a child ten months old. After two months' treatment the knee could be flexed to a right angle.

* See a valuable paper by Mr. Shattock on "Genu recurvatum" in Path. Soc. Trans., vol. xlii., 1891, p. 280.

XXXVI. INJURIES OF THE HEAD.

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GENERAL CONSIDERATIONS.

INJURIES of the head possess special interest for the surgeon, because of the liability of the brain to be involved, directly or indirectly, in the result. An injury to some part of the head, in itself perhaps quite a trivial matter, such as a simple fracture of the skull, may be associated with very extensive injury to the brain, or even if the brain is not seriously injured at the time of the accident, most grave results may follow within a short time of the infliction of the injury. Hence the truth of the well-known saying of Hippocrates, "*Nullum capitis vulnus contemnendum*," is often very forcibly brought home to us.

The structures forming the head fall naturally into three groups: externally, the soft parts constituting the scalp; internally, the brain and its membranes; and between these a protecting bony layer, the skull. Inasmuch as a slight injury of the scalp or of the skull is often associated with serious injury to the brain, or may subsequently lead to grave affections of that organ, it will be more convenient and will help us in obtaining a clearer understanding of head injuries if we commence our subject by a consideration of the effects of injuries of the head upon the brain.

Of recent years an enormous advance has been made in cerebral surgery, and this progress may be traced to two causes. One is the discovery of the localisation of functions in various parts of the brain, the other is the prevention of suppuration by adopting the principles laid down by Sir Joseph Lister. For the first successful application of these advances in our knowledge we are indebted to two British surgeons, Macewen and Horsley.

It will save frequent repetition if we commence the account of head injuries by considering (1) some practical points concerning the localisation of function in the brain, (2) the topography of the brain in relation to the skull, and (3) some points in the operative surgery of the brain.

1. **The localisation of function in the brain.**—Although the function of many parts of the brain is still unknown, and as to that of other parts a great divergence of opinion exists, yet there are certain regions the functions of which can be stated with considerable certainty. These portions are the convolutions in the region of the fissure of Rolando, the occipital lobe, and the temporo-sphenoidal lobe.

(a) **The Rolandic area.**—The limits of this area will be readily seen on referring to Fig. 534. Nearly all observers are agreed concerning the motor functions of this area, and the balance

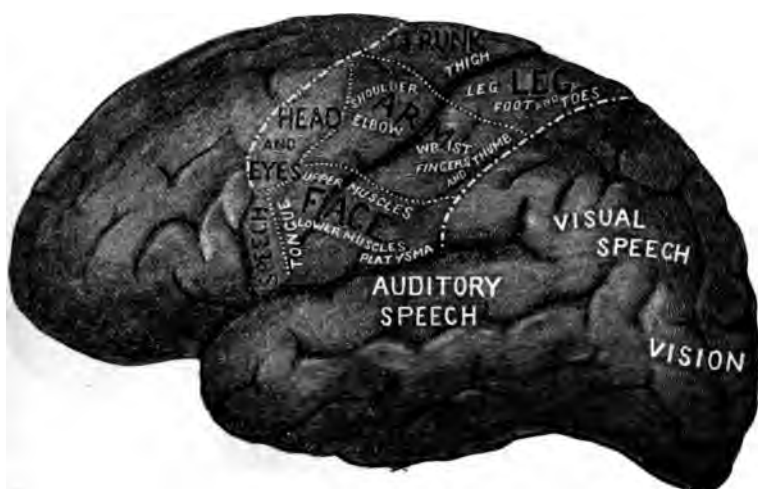


Fig. 534.—Outer surface of the Left Cerebral Hemisphere, showing sensori-motor area, speech areas, and visual area.

of evidence is strongly in favour of the view that cutaneous sensations and the muscular sense are represented in this region also. It should be called, therefore, the *sensori-motor area*. In the figure the subdivisions of this area have been sharply limited by dotted lines. This is for the sake of clearness only. It must be understood that there is no definite line of demarcation. Any particular movement has a wide representation in the cortex, but there is also a limited area where the function is most specialised, and this is looked upon as the motor area, *par excellence*, for that group of muscles.

In monkeys the mesial surface of the hemisphere in front of the paracentral lobule has been definitely proved to be related to the movements of the trunk. In man the evidence of this localisation is not so definite; but, on clinical grounds, there is good reason to believe that there is a representation of the trunk muscles on the mesial surface just in front of the leg area. (See Fig. 535.)

INJURIES OF THE HEAD.

(b) **The occipital lobe.**—In this region the function of vision is localised. Each lobe is connected with half the retina of each eye, so that a lesion in one occipital lobe produces hemianopsia, *i.e.* half blindness in each eye, the blind field of vision being on the opposite side to the lesion.

(c) **The temporo-sphenoidal lobe.**—In all probability the function of hearing is localised in the first and second temporal convolutions. Each ear is connected with both hemispheres, so that a lesion in one temporo-sphenoidal lobe causes only partial deafness, which may easily escape notice. A lesion in each lobe causes total deafness.



Fig. 535.—Medial surface of the Left Cerebral Hemisphere, showing sensori-motor areas for leg and trunk, and the areas for vision and for smell and taste.

It is conjectured, but with no definite clinical or experimental proof, that the functions of smell and taste are localised at the tip of the temporo-sphenoidal lobe.

So far as we know at present, the functions of no other part of the brain are sufficiently well localised to be of any practical importance in regional diagnosis.

The function of *speech* is a complicated one, and is connected with the sensori-motor area, with vision, and with hearing. It is limited to the left hemisphere in right-handed persons and to the right hemisphere in left-handed persons.

Motor speech.—The muscles concerned in the act of speaking are connected with the posterior part of the third frontal convolution. (See Fig. 534.) Lesions in this area cause inability to express ideas correctly in words, *i.e.* *motor aphasia*.

Auditory speech.—The memories of word-sounds are stored up in the first and second temporal convolutions (see Fig. 534), so that in lesions of this area the understanding of spoken language and

the ability to remember the names of objects are lost, i.e. *word-deafness*.

Visual speech.—The memories of printed words are stored up in the angular gyrus; so that in lesions of this area, the understanding of written language and the power to read are lost, i.e. *word-blindness*.

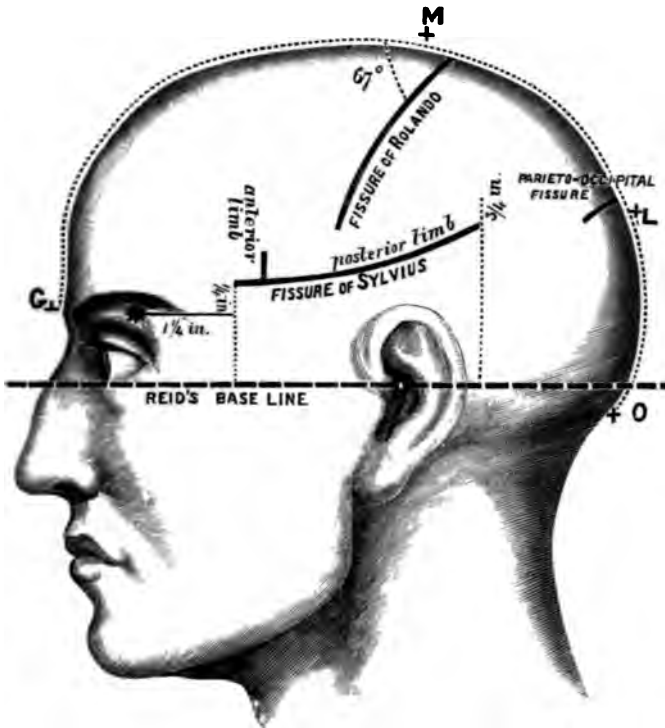


Fig. 538.—G, Glabella; O, occipital protuberance; M, a point midway between G and O; L, lambda; °, external angular process of frontal bone.

Writing.—The ability to write is usually lost when there is motor aphasia. The exact site of this function is not known. It is probably situated near the hand area.

2. The topography of the brain for purposes of operative surgery.—Numerous methods have been described for marking on the surface of the head the fissures and convolutions of the underlying brain. It is, of course, impossible to mark them out with mathematical accuracy, but it is possible to localise them with sufficient precision for surgical operations on the brain. For practical purposes there are five important lines to determine.

(1) **Reid's base line.**—This is a very convenient line, from

which certain measurements can be made. It is marked out by drawing a straight line from the lower margin of the orbit backwards through the centre of the external auditory meatus. (See Fig. 536.)

(2) **The lower margin of the cerebrum.**—This is fairly accurately indicated by a line drawn from a point half an inch above the external occipital protuberance, passing forwards through a point half an inch above the centre of the external auditory meatus. (See Fig. 537.)

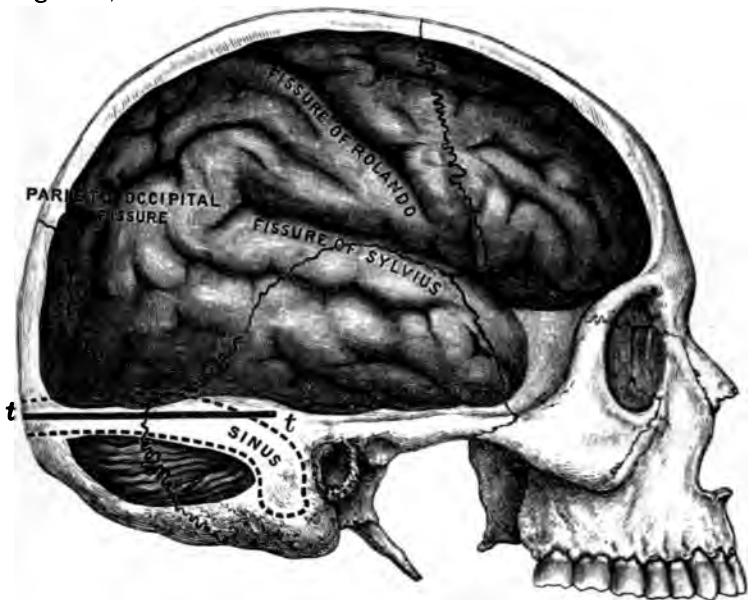


Fig. 537.—Showing relations of the Bones of the Skull to the Brain, Lateral Sinus and Tentorium Cerebelli.

t t, Line of attachment of the tentorium to the inner surface of the skull.

(3) **The fissure of Rolando.**—According to Thane, the upper end of the fissure corresponds to a point half an inch behind a point midway between the glabella and the external occipital protuberance. Hare has shown that on an average the fissure of Rolando makes an angle of 67° with the longitudinal fissure. Its average length is $3\frac{1}{2}$ in., so that a line drawn from Thane's point, downwards and forwards, at an angle of 67° with the middle line, will mark out the fissure of Rolando with precision sufficient for all practical purposes. In children the angle is smaller, varying between 52° and 67° , and owing to the slighter development of the frontal lobes relative to the rest of the brain, the fissure of Rolando is situated farther forwards.

Various instruments have been devised for marking out the

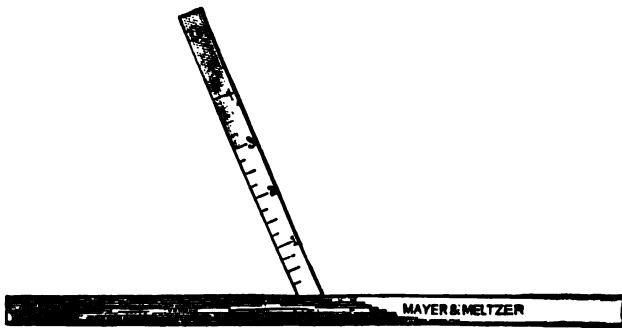


Fig. 533.—Horsley's Cyrtometer.

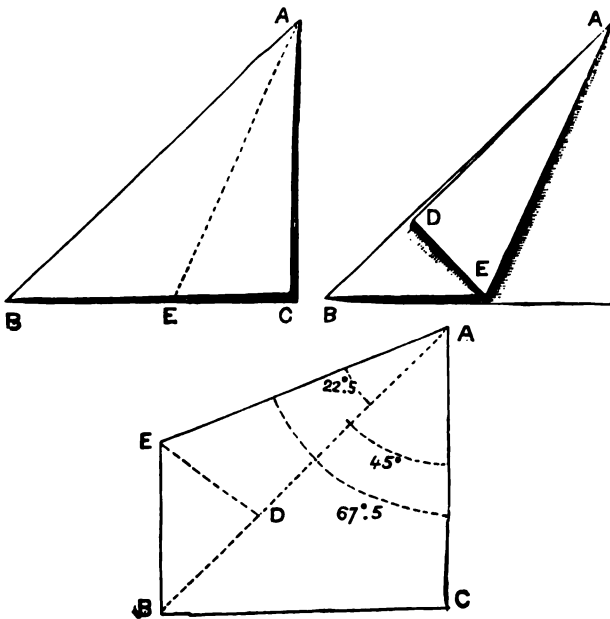


Fig. 533.—A Method for determining the Angle made by the Fissure of Rolando with the Mesial Line.

fissure of Rolando. The simplest is the cyrtometer designed by Horsley, and shown in Fig. 538. It is made of flexible metal, and can be made to lie evenly on the head. If no cyrtometer can be obtained, the angle of 67.5° , which for surgical purposes is near enough, can be ascertained in the way described by Chiene. A square piece of paper is folded as shown in Fig. 539, so as to form a triangle. By folding one layer of the paper along the line AE , and by turning back the original fold AB , the angle of 67.5° is readily obtained.

(4) **The Sylvian fissure.**—Reid's base line must be first drawn. From the external angular process of the frontal bone draw a line

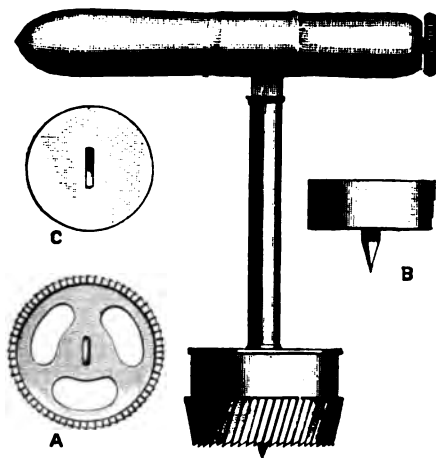


Fig. 540.—Modern Aseptic Trephine.

A, From below with pin removed; B, the pin; C, upper surface of the pin, showing a small depression to fit into the elevation shown in A (in order to fix the pin).

backwards parallel with Reid's base line for $1\frac{1}{4}$ inch, and then measure $\frac{1}{4}$ inch upwards. This point gives the commencement of the fissure. To find the termination draw a line from the most prominent part of the parietal eminence downwards at right angles to Reid's line. A point $\frac{3}{4}$ inch from the commencement of this line will correspond to the termination of the fissure of Sylvius. (See Fig. 536.)

The anterior limb of the fissure commences 2 inches behind the external angular process of the frontal

bone, and passes vertically upwards for 1 inch. The posterior limb is about the same length as the fissure of Rolando—that is, $3\frac{1}{2}$ inches.

(5) **The parieto-occipital fissure.**—This is of service in determining the anterior limit of the occipital lobe. It is situated half an inch in front of the lambda, *i.e.* a point $2\frac{1}{2}$ inches above the external occipital protuberance. The depression of the lambda can generally be felt through the scalp.

The left hemisphere is, in right-handed persons, larger than the right, so that the longitudinal fissure of the brain is just on the right side of the middle line.

The attachment of the tentorium to the side of the skull is indicated by a line drawn from a point just above the external occipital protuberance to a point $1\frac{1}{4}$ inch behind, and $\frac{3}{4}$ inch above the centre of the external auditory meatus. (See Fig. 537.)

3. The operative surgery of the brain.—For the first clear and precise directions for operating successfully upon the brain we are indebted to Victor Horsley's account published in 1886. Since then an enormous number of cases have been reported in which the cranial contents have been explored with impunity, and pathological products removed with success.

Preparation of the patient.—In addition to the measures usually adopted before any surgical operation is performed it is essential that the head be completely shaved.

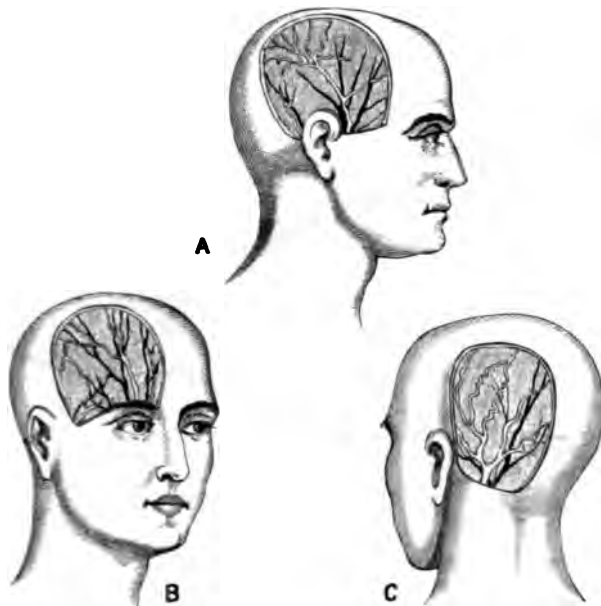


Fig. 541.—Horseshoe-shaped Flaps, designed to interfere with vascular supply as little as possible.

A, Temporal; B, frontal; C, occipital region.

The scalp must be well cleaned with soap and water, rubbed with ether, and covered by a compress of carbolic acid or sublimate lotion. The line of the fissure of Rolando, or any point that may be required, should be mapped out with silver nitrate or a sterilised aniline pencil. Many patients requiring operations on the brain have frequently been taking large doses of bromide of potassium. It is most important to discontinue the administration of this drug as long as possible before the operation, as it renders the patient less able to withstand the shock.

Administration of the anæsthetic.—It is of little moment which anæsthetic is used; Horsley prefers chloroform, as he considers it causes "less cerebral excitement," and advises that a hypodermic

injection of morphia should be given before the administration of the anæsthetic is commenced.

The patient's head should be well raised during the operation.

The skin incision.—Before turning back a flap it is advisable to make a mark on the bone where it is desirable to trephine; this is best done by knocking the pin of a trephine through the scalp on to the bone so as to make a characteristic mark. The pin of a modern trephine (*see* Fig. 540) is but little adapted for this purpose, and I have found it convenient to use a special instrument with a point like that of a pin of a trephine. If exact localisation is desired it would be well to mark the two ends of the fissure of Rolando or any other point in the same way. The skin flap should be horseshoe-shaped, and so arranged that as few main arteries and

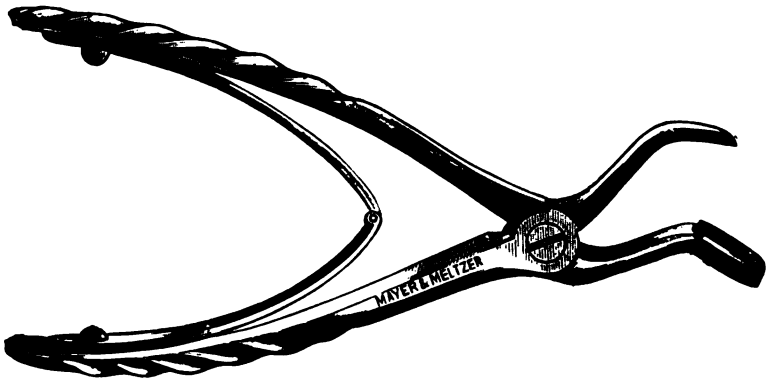


Fig. 542.—Sharp-edged Gouge Forceps.

nerves as possible should be cut. (*See* Fig. 541.) It matters but little how the pericranium is dealt with; it is tedious to turn it down with the skin-flap as some recommend. It is better to make a crucial incision into it and reflect it with a periosteal elevator or rugine.

Opening the skull.—Many methods of opening the skull have been employed; and of recent years numerous improvements have been made.

(a) By the trephine. The time-honoured method of removing a disc of bone by means of a trephine (*see* Fig. 540), worked by the hand, is still the most convenient method for operating under ordinary circumstances. The diameter of the trephine which is used depends upon the nature of the case. For many purposes a diameter of $1\frac{1}{2}$ to 2 inches is found most convenient. If it be desired to increase this aperture to a slight extent the sharp-edged gouge forceps, shown in Fig. 542, are very useful. If the bone be thin it may be removed in one cut, as in Fig. 543 A, but if the bone be thick it should be cut in two stages, as shown in Fig. 543,

b and c. This could not be done with the ordinary gouge forceps, but with the sharp-edged forceps a very thick skull can be cut through. If a much larger hole be required another disc should be removed by a trephine, and the bridge of bone between the two holes should be partly cut through by a saw, and the separation completed by strong bone forceps.

(*b*) By the saw. There are certain cases where trephining by hand might be very inadvisable; for instance, in cases of severe cerebral compression, where the necessary pressure of the hand upon the trephine still further increases the intra-cranial pressure, and may

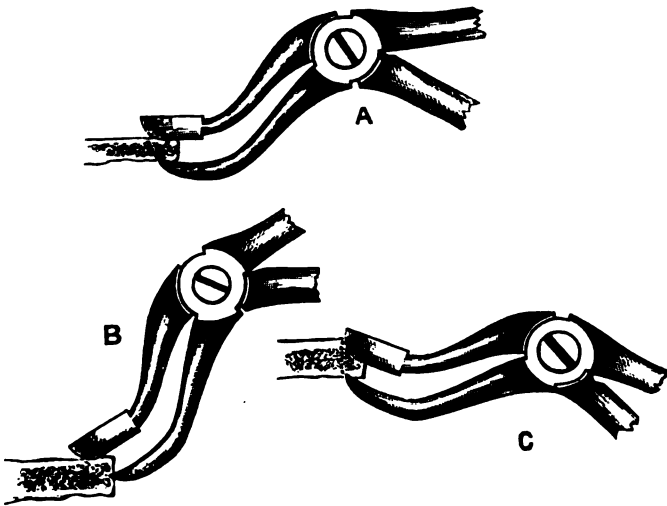


Fig. 543.—Modes of using the Sharp-edged Gouge Forceps.

even go so far as to cause cessation of respiration. To meet this objection, and at the same time to work more quickly, Horsley has used circular and linear-cutting saws worked by electricity, and cutting so readily that very little pressure is necessary. These can only be used when plenty of assistance is at hand, and to avoid accidents great care is necessary.

(*c*) By the spiral osteotome. A decided advance in the method of trephining has been introduced by Dr. Cryer, an American dental surgeon. By using an improved surgical engine and suitable cutting instruments the operation of trephining can be conducted with extraordinary rapidity and without exerting any injurious pressure upon the skull. A small disc of bone is first removed by means of an ordinary trephine rotated at great velocity by the surgical engine. As soon as the disc of bone has been removed the trephine is replaced by the spiral osteotome shown in Fig. 544. The metal button (*B*) against which the spiral osteotome (*A*) rotates, gently depresses the dura mater

and prevents any injury to that membrane. By this instrument the bone is cut with great rapidity, and in a minute or two several square inches of bone can be removed.

(d) By the chisel. Of recent years, especially in Germany, the chisel has, to a certain extent, replaced the trephine. The repeated blows found necessary to cut through the bone must be injurious to the underlying cranial contents, especially if much cerebral compression be already present.

(e) Temporary resection of the skull. Of recent years Wagner has practised a new method of opening the skull, and his example has been followed by several surgeons. The principle of the method is to turn back a horseshoe-shaped flap composed of scalp and bone in one piece. The scalp is divided with a knife, and then a groove is cut in the bone with gouges (*see* Fig. 545), so as to expose

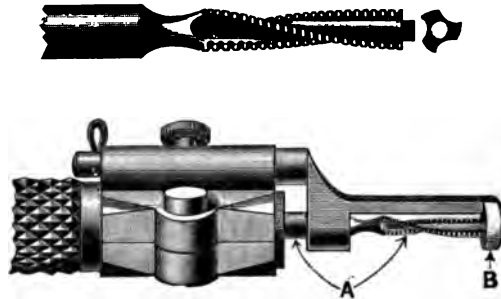


Fig. 544.—Spiral Osteotome.

the dura mater along the whole edge of the flap. By lifting up the bone with force the base of the bony flap is broken through, and, together with the scalp, can be turned down while the brain is exposed. (*See* Fig. 545.)

If the hæmorrhage from the cut bone is at all troublesome it can readily be stopped by rubbing into the bone some sterilised wax.

After the dura mater is sewn up the flap is replaced, and the wound in the scalp sutured. In some hands this method has been found superior to trephining, but the objection that has already been raised against the use of the chisel applies equally well in this case.

Opening the dura mater.—This may be opened by a semi-circular flap or by a crucial incision. A small incision should be made into the dura mater by means of a scalpel, and the opening enlarged with a blunt-pointed pair of scissors.

If any vessel in the dura mater is cut—for example, the trunk of the middle meningeal artery or one of its branches—a suture should be passed through the dura mater so as to include the vessel, and then tied.

The treatment of the brain.—If antiseptic fluids have been used for sponging the wound prior to opening the dura mater, they should be discontinued after the opening has been made, and in their stead sterilised salt solution (0·6 per cent.) should be employed.

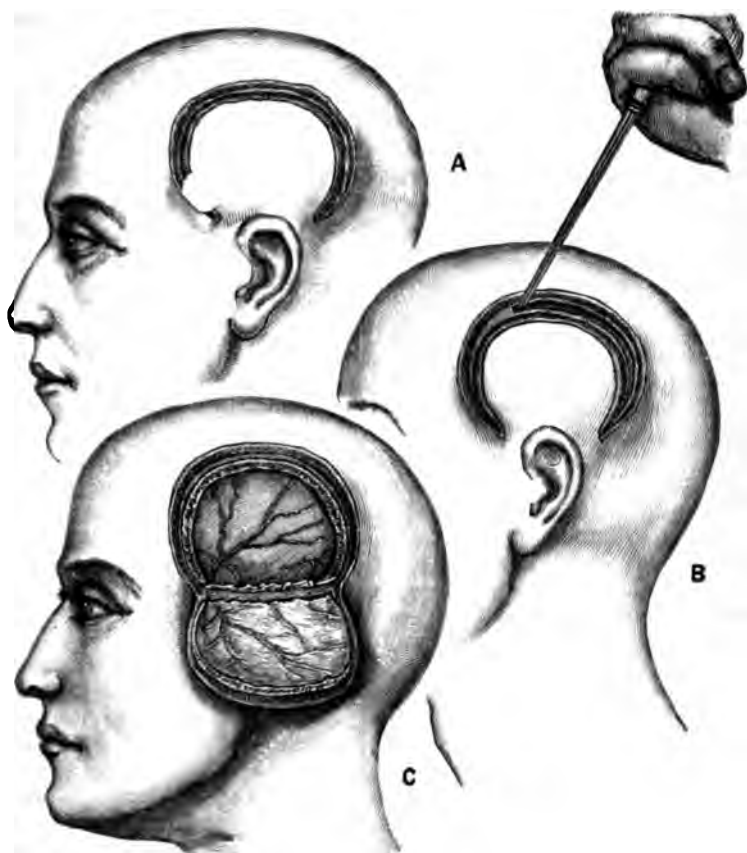


Fig. 545.—Temporary Resection of Skull.

A, incision through soft tissues down to the bone; B, a groove being cut in the bone; C, flap of bone and soft tissues turned down en masse.

This is important for two reasons: first, the fact that antiseptic lotions tend to diminish the excitability of the cerebral cortex to electrical stimulation, which, for the purpose of localisation, may be necessary; secondly, after irritating lotions have been applied to the cortex, inflammatory reaction is more likely to occur. Having opened the dura mater, it is important to observe the following points:—

(a) *Bulging of brain.*—When the cranial contents are normal the brain does not tend to bulge through the trephine hole. Any bulging, therefore, indicates increased intra-cranial tension.

(b) *Pulsation of brain.*—Normally, pulsations, synchronous with the heart, and to a less extent with respiration, can be observed. When the intra-cranial pressure is only slightly raised the arterial pulsations may still be observed, but complete absence of pulsation in the brain indicates severe intra-cranial tension.

(c) *Œdema of the pia mater and arachnoid.*—This may sometimes be so marked as to obscure, more or less, the sulci and convolutions. When very marked it is indicative of general intra-cranial tension, such as that produced by lepto-meningitis.

(d) *Colour of the brain.*—Great experience is necessary to interpret the signification of slight alterations in the colour of the brain. According to Horsley, a slight yellowish tinge, or an opposite condition of lividity, may indicate a sub-cortical tumour.

(e) *Resistance of brain.*—By palpation the existence of fluid beneath the convolutions would be suspected, with a sensation of fluctuation. On the other hand, an increased resistance would indicate the presence of a growth or chronic inflammatory process. Sometimes, in the case of sub-cortical tumours, by pushing a needle into the brain a definite alteration in resistance is noticed.

In removing any portion of the brain the incisions should be made with a blunt knife, so as to wound as few vessels as possible. The incisions should be made perpendicular to the surface, as the vessels are running in that direction. Horsley's flexible brain knife will be found very useful for this purpose, as any slight alteration in the direction required can be easily made. Hæmorrhage from the brain substance, if slight, can be checked by the pressure of a sponge, or of some hot lotion. If bleeding occurs from vessels of considerable size, it may be necessary to pass a catgut suture through the brain tissue, including the vessels, and to tie the mass together. After a portion of brain has been removed, no permanent cavity is left. The cut surface soon rises to the level of the convolutions.

Replacing the bone and drainage.—When the dura mater can be sewn up, the bone should be replaced. In order to prevent the bone from losing its vitality during the temporary removal from the skull, it should be kept warm between sponges, or in warm sterilised salt solution (0·6 per cent.). It is better to replace the bone entire, and not to break it into smaller pieces. Portions of bone two inches in diameter will retain their vitality when treated in this way.

Unless there is a special reason for drainage, as after opening abscesses of the brain, etc., it is not necessary to drain the wound. Uniform elastic pressure by means of ordinary bandages and cotton wool dressing is quite sufficient to limit the amount of inflammatory exudation.

Shock after operations on the brain.—After prolonged

operations on the brain, the shock is sometimes very great, and occasionally fatal. It is always advisable, when possible, to divide the operation into two stages. At the first operation the necessary amount of bone should be removed; and at the second operation, a few days later, the dura mater should be incised, and the brain dealt with.

INJURIES OF THE BRAIN AND OF ITS MEMBRANES.

The brain of the adult differs from all other organs in the body, in the fact that it is situated in a cavity, the wall of which is so unyielding, that only violence of considerable magnitude can alter in any way the capacity of the cavity. At the end of the last century it was almost universally taught that the cranial cavity contained only the brain and the blood nourishing it. Inasmuch as the cranial cavity was incapable of alterations in size, they concluded that the amount of blood circulating in the brain was always the same; in other words, that just as much blood flowed away from the brain as was carried to it.

The fallacy of this view was shown by the discovery of Magendie that there was a third factor present; that, in addition to the brain and its nourishing fluid, there was the cerebro-spinal fluid, situated between the brain and spinal cord on the one hand, and the skull and vertebral column on the other—in some places, as the base of the brain, occupying a considerable space. By numerous observations and experiments several observers have shown that the volume of the blood in the cranial cavity is subject to constant changes, owing to the cardiac and respiratory movements, and they naturally turned to the cerebro-spinal fluid as furnishing the means by which such a varying amount of blood could be contained within the skull. These observers have shown that with each systole of the heart the brain and spinal cord expand, and that with each diastole they contract; that with each inspiration the brain and spinal cord contract, and that with each expiration they expand.

Several theories have been advanced to explain the mechanism by which the volume of the brain and spinal cord may continually vary within the firm walls of the cerebro-spinal axis. It has now been definitely proved that the cerebro-spinal fluid finds room for itself in one or both of two ways:—

- (a) By leaving the cerebro-spinal cavity by certain lymph tracks.
- (b) By the theca vertebralis becoming distended, and so making room for the cerebro-spinal fluid.

That paths do exist by which the cerebro-spinal fluid can escape from the sub-arachnoidal space the following observations show. Schwalbe demonstrated that the optic and auditory nerves contained a prolongation of the arachnoidal membrane, so that the sub-arachnoidal fluid could pass along the sheaths of the nerves. Then Key and Retzius demonstrated the existence of such a prolongation along all the cranial and spinal nerves, and these observers

also confirmed the experiments of Quincke, who showed that the Pacchionian bodies contained lymph spaces, which carried cerebro-spinal fluid from the sub-arachnoidal space into the venous sinus.

That the theca vertebralis may be distended, and so make room for more cerebro-spinal fluid, is possible, although difficult to prove. It can easily be seen that if the theca be exposed by removal of the neural arch of a vertebra, it does expand when the sub-arachnoidal pressure is increased, but this fact does not prove that such a distension takes place before the support to the theca is withdrawn. It must be borne in mind, however, that the theca is not in immediate contact with the bony wall of the spinal canal, but that some fat and a vascular plexus lie between the theca and the wall of the vertebral canal, so that there may be room for a distension of the theca.

In addition to this safety-valve action of the cerebro-spinal fluid, we must bear in mind that the fluid is distributed very widely throughout the brain and spinal cord, permeating, in fact, the whole nervous tissue. By means of the lymphatic sheaths surrounding the vessels entering the brain, cerebro-spinal fluid is carried along the ultimate ramifications of the vessels, and around the nerve cells are spaces which communicate with these peri-vascular lymphatics. By means of the foramina of Magendie, and of Key and Retzius in the roof of the fourth ventricle, free communication is assured between the fluid in the ventricles and that in the sub-arachnoidal space.

It is obvious that any disturbance in the cerebro-spinal fluid will make itself felt throughout the whole of the central nervous system. In normal circumstances the safety-valve action already described is sufficient to keep the pressure of the cerebro-spinal fluid fairly constant, but if the sub-arachnoidal space is encroached upon, either temporarily, as in concussion of the brain, or more or less permanently, as in compression of the brain, the resulting change in the cerebro-spinal fluid may be most far-reaching.

Concussion of the brain.—By the term concussion of the brain is meant a condition into which a person passes after a blow upon the head, and of which the leading features are sudden loss of consciousness, together with a great weakness in the action of the heart and of the respiratory muscles.

Ætiology and pathology.—It is universally admitted that a blow, or a succession of blows, either on the head itself, or transmitted to the head through the vertebral column, is necessary for the production of concussion of the brain. A great diversity of opinion exists, however, concerning not only the way in which the force produces such great effects, but also the appearance of the brain after death from such a cause. The theories concerning concussion may be classified into three groups:—

1. *Molecular disturbance.*—That the vibrations into which the skull is thrown are communicated to the brain, and that these vibrations permeate the whole of the brain. It is thus a shaking-up, or true *commotio cerebri*.

2. *Multiple hæmorrhages.*—It was stated by the older surgeons that after death from pure concussion no structural alteration could be found in the brain, and that there was a sharp line of demarcation between concussion and contusion or laceration of the brain. The more exact observations of modern surgeons and pathologists seem to point to the conclusion that in nearly all fatal cases there are either numerous minute hæmorrhages or definite lacerations of the brain substance. It by no means follows, however, that these lesions are the cause of the symptoms or of the fatal result, and most surgeons are agreed that the hæmorrhages are not sufficient to produce all the symptoms.

3. *Vascular disturbance.*—The majority of observers agree that there is an anæmia of the brain in concussion; but they differ concerning the mode of production of this anæmia. It is sufficient to mention Duret's theory, which is based upon clinical and experimental observation. According to Duret there is at the point of the skull struck a depression which he terms the "cone of depression," and at a point opposite to this there is a "cone of bulging" of the cranial wall. The alteration in the wall of the skull thus produced tends to force the cerebro-spinal fluid from the lateral ventricles through the third ventricle and sylvian aqueduct to the fourth ventricle, whence it escapes by the foramina in the roof of the fourth ventricle. The inflow into the fourth ventricle is greater than the outflow, and hence the ventricle becomes distended, and this distension stimulates the restiform bodies and produces an anæmia of the brain. Duret is of opinion that the minute hæmorrhages throughout the brain are caused by the vessels losing the support of the cerebro-spinal fluid.

The discussion of these views, many of them highly theoretical, cannot be further pursued.

Symptoms of concussion.—The symptoms of concussion of the brain vary according to the severity of the injury. In cases of slight injury there may be simply a loss of consciousness for a few seconds, with arrest of respiration and pallor. In such cases recovery is rapid. On the other hand, in cases of severe injury the person may die in the course of a few minutes. The cases that come more especially under the surgeon's notice are intermediate between these two forms, and the symptoms may be divided into three stages.

1. *The stage of collapse.*—The loss of consciousness is always sudden. The degree of insensibility varies. In some cases the patient may be roused by shouting or by pricking him; in other cases the insensibility is complete. In fact, there is every grade between partial and transitory loss of consciousness and complete insensibility. The duration may vary from a few seconds or minutes to several hours or days.

Circulatory system.—In all cases the pulse is very weak. The rate is liable to variations. As a rule, there is distinct slowing, but sometimes the frequency is increased. In all probability the pulse

is always slow immediately after the injury. That the cutaneous vessels are very empty is shown by the pallor and coldness of the skin.

Respiratory system.—The respirations are slow and very shallow, occasionally very irregular in force and rhythm. The irregularity in force is especially emphasised by an occasional sighing inspiration.

Motor system.—All the muscles are relaxed and the patient lies motionless, but this paralysis is only temporary. As soon as the patient recovers consciousness the muscles can be used, so that the paralysis is only a functional one. That the paralysis is not absolute is shown by the fact that there is no stertor and no blowing out of the cheeks during expiration. (See pages 113 and 115.)

Sensory system.—In moderate degrees of concussion the patient can be roused to a certain extent by pinching or pricking the skin. In severe cases there is no reaction to cutaneous stimulation.

Reflexes.—The superficial reflexes and the knee-jerks are absent in well-marked concussion. In such cases the corneal reflex is absent. In mild cases the reflexes are present, though sluggish.

Pupils.—In simple concussion, unaccompanied by compression, the pupils are equal and more or less dilated. The reaction to light varies according to the degree of concussion. In severe cases it is present, but decidedly sluggish. Only in very grave cases is the light reflex unobtainable.

Rectum and bladder.—The sphincters of both these organs are relaxed; but the organs themselves are not paralysed, and are able to expel their contents, hence there is incontinence both of urine and feces.

Temperature.—The rectal temperature is always subnormal, sometimes reaching 96° F. or 95° F. There is no difference in the surface temperature of the two sides of the body.

2. *The stage of reaction.*—The stage of collapse may last a variable time, from a few minutes to several days. Sooner or later the collapse, except in fatal cases, begins to disappear, and one of the first signs of recovery is vomiting. Occasionally an epileptiform attack may occur. There is a gradual improvement in the circulation, the pulse becomes stronger and the skin warmer. The respirations become deeper and more regular, and there is a gradual return to consciousness. As a rule the temperature rises, seldom above 100° F., and the pulse becomes full and bounding. Headache is frequently present. If the patient is suffering solely from concussion the stage of reaction rapidly passes into that of convalescence. If, however, there be any compression or laceration of the brain, signs of these conditions are usually present in this stage. Occasionally during the reaction stage the patient may become comatose and die, with symptoms pointing to encephalitis or spreading oedema.

3. *The stage of convalescence.*—In pure cases of concussion the patient rapidly passes through the stage of reaction and gradually recovers his normal state. The stage of convalescence varies in

duration from a few days to weeks, or even months. In cases of prolonged convalescence there has probably been some contusion or laceration of the brain. This explanation will probably account for those patients who never recover their previous activity of mind, and who present certain disorganisations of sensory functions.

Diagnosis and prognosis of concussion.—The *diagnosis* will be considered in connection with compression of the brain. (See page 115.)

In uncomplicated concussion the *prognosis* is very favourable, the majority of cases making a complete recovery. Signs of compression or laceration of the brain showing themselves during the stage of reaction would, of course, modify the prognosis.

Treatment of concussion.—The treatment varies according to the stage of concussion which the patient is in.

Stage of collapse.—The patient should be placed between warm blankets, and hot bottles should be applied to his feet, legs, and trunk. Gentle friction with warm flannel or warm hands to the surface of the body is advisable. An enema of warm water or warm beef-tea is frequently useful. If the collapse be very great, brandy should be given by rectal injection or hypodermically. Alcohol should not be given, however, unless the degree of collapse is very great and stimulation is strongly indicated. The objections to the administration of alcohol in concussion are first, that the blood pressure is raised, and ruptured vessels may commence bleeding; and secondly, that it tends to cause a hyperemia of the brain, and favours the occurrence of a spreading œdema. (See page 119.)

If the stage of collapse is of long duration, and the patient cannot be made to swallow, a tube should be passed into the stomach and nutritious liquid food administered.

Stage of reaction.—The diet should be light and the bowels well opened by purgatives or enema. The patient must be kept in a quiet and darkened room. When the reaction is considerable the head should be shaved and cold applied by means of Leiter's tubes. Stimulants should on no account be given.

Stage of convalescence.—Any work or mental excitement must be avoided during convalescence. Rest, fresh air, and light diet are important factors in a rapid recovery.

Contusion or laceration of the brain.—There is no sharp line of demarcation between concussion and contusion of the brain. In the majority of cases of concussion it has been pointed out that there are definite lesions—minute contusions, in fact. The chief point, however, is that in concussion there may be no contusions; or if they are present, they cannot in themselves cause the symptoms of concussion. By contusion or laceration of the brain is meant an injury so great that by itself it may cause symptoms, or be followed by grave symptoms independent of the symptoms of concussion.

Ætiology and pathology.—It is obvious that a foreign body, such as a bullet or a sabre, may directly produce a bruise or laceration of the brain. In these cases the nature of the injury can,

as a rule, be readily determined. In the majority of cases, however, the contusion is produced much less directly, and the mode of its production is by no means obvious.

A commonly accepted theory is that when the head is struck a movement is communicated to the skull and to the brain within. When the skull is suddenly stopped in its movement the brain tends to continue its motion, and will therefore tend to impinge upon the inner surface of the skull on the side opposite to that struck, *i.e.* contusion by *contre-coup*.

On the other hand, Duret explains the contusions as being caused by the disturbance in the cerebro-spinal fluid, brought about in the way already discussed when describing the ætiology of concussion. The "cone of elevation" so alters the pressure relations of the cerebro-spinal fluid opposite to the point struck that the support afforded by the fluid to the wall of the vessels is diminished, and as a consequence the vessels rupture. In other words, Duret considers that there is a tendency to the formation of a vacuum around the vessels; under which conditions the walls of the vessels cannot withstand the blood pressure.

Symptoms.—An injury sufficiently great to cause contusion or laceration of the brain must have caused the symptoms of concussion. If the laceration be a large one, the extravasated blood will cause a certain amount of compression, so that the symptoms of contusion or laceration are for the first three or four days usually masked by those of concussion and compression. In cases uncomplicated by compression the evidence of laceration of the cortex, if situated in the sensori-motor area, usually reveals itself within twenty-four hours by clonic spasms or rigidity in certain groups of muscles. If the injury is extensive, more or less paralysis of muscles may exist. In other cases there may be no evidence of laceration until the fourth or fifth day, or even later, when convulsions or rigidity of muscles may appear. In these cases the symptoms are due to vascular changes taking place around an injury which by itself caused no symptoms. These vascular changes are probably of the nature of a spreading œdema, the mechanism of which is described later. (See page 119.)

Following contusion of the brain, frequently within a few hours, a peculiar train of symptoms may appear in which the mind rather than the body is affected. This condition is often called *cerebral irritation*, but this term does not express well the symptoms that are present. There are no signs of irritation of that part of the cortex in which function is known to be localised, and therefore the term *mental irritation* seems a more suitable one. The symptoms are probably caused by contusion and laceration of the brain, especially in the region of the frontal lobes. The patient lies on his side curled up in bed, with the limbs flexed, and the back curved forwards. The eyelids are kept closed, the urine and fæces are usually passed in the bed, but the patient may be induced sometimes to use a bed-pan. The pupils are contracted and react to

light; the temperature is normal or sub-normal, and the pulse slow and weak. The characteristic feature is intense irritability of temper. The patient objects to be roused, and if efforts at rousing him are persisted in, strong, and even blasphemous, language may be used. Food is usually taken when offered, or may be eaten by the patient if left at the side of the bed.

After an interval varying from one to two or three weeks these symptoms gradually disappear, and the patient may recover completely. In some cases the mind may be affected for some time after the acute symptoms have subsided, or it may be permanently injured. On recovering from this condition, the patient is either completely oblivious of the state in which he has been, or may have only a hazy recollection.

Diagnosis.—Immediately after the accident it is impossible to diagnose the existence of contusion or laceration. The symptoms of concussion which are always present, and the frequent occurrence of compression, conceal the symptoms that might be produced by the contusions. The onset of convulsions, rigidity or paralysis of groups of muscles coming on between the second and fifth day, points strongly to contusion. It has been stated that œdema of the optic nerve or of the retina is often present in these cases, but absent in pure concussion.

Prognosis and results.—The prognosis depends chiefly on the extent of the injury, and whether septic infection takes place or not. In slight cases the circulation of blood in the region of the laceration is profoundly affected, and an œdema may set in which tends to spread indefinitely and causes death. (See page 119.)

Sometimes the bruised cerebral tissue forms a suitable medium for the growth of micro-organisms leading to a fatal *acute encephalitis* in which after death a diffused purulent condition of the brain is found. This septic encephalitis may remain localised and lead to the formation of a definite abscess.

The disintegrating process favoured by the spreading œdema may lead to a gradual necrosis of the brain known as *yellow softening*. The extent of this softening depends upon the amount of vascular disturbance around the laceration.

Changes more remote than these may take place. For instance, the lacerated tissue with the extravasated blood may undergo changes leading to the formation of a *cyst* containing a turbid serous fluid. In some cases considerable scar tissue is formed, which seems to irritate the adjacent tissue, and if situated in the sensori-motor area may give rise to *traumatic epilepsy*. (See Diseases of the Brain, page 216.)

An extensive formation of fibrous tissue spreading from the original injury may lead to considerable interference with the functions of the brain, causing the condition known as *interstitial encephalitis*.

In all cases where the cerebral cortex in the sensori-motor area has been lacerated, a descending degeneration takes place, passing down the pyramidal tracts into the spinal cord.

Treatment.—In any case of concussion where the symptoms do not disappear within a day or two, contusion or laceration of the brain should be suspected. The patient must be kept absolutely quiet, the head shaved, and an ice cap or Leiter's tubes applied. In fact, the treatment recommended for concussion should be adopted.

If there are signs of compression from extravasating blood, trephining is indicated; if, later, symptoms of abscess develop, the pus should be evacuated if its situation can be ascertained.

Compression of the brain.—When considering the subject of compression of the brain it must be clearly understood at the outset that there are two distinct varieties of compression. These generally occur together, but occasionally one may be present without the other. They are:—

1. A general compression of the whole central nervous system, brought about by a rise in the pressure of the cerebro-spinal fluid in the sub-arachnoidal space.

2. A local compression of some particular portion of the central nervous system, the compressing agent exerting its action on the nervous tissue directly.

This latter method is the one to which the term cerebral compression ought strictly to be applied, as by it pressure may be exerted on the brain alone; whereas in the first variety the pressure is distributed equally over the whole cerebro-spinal axis. Clinically, either of these varieties may occur. Thus the first kind may be produced by meningitis, with effusion into the sub-arachnoidal space. The second variety may be produced by a blood-clot pressing on the brain; and provided the clot is a small one, there may be no rise of general cerebro-spinal pressure. No doubt the formation of this clot is accompanied by some increase in the sub-arachnoidal pressure; but if the clot be small, this increase of pressure may soon subside, and only the evil effects of a local pressure on the brain remain.

The important part played by the cerebro-spinal fluid in the normal conditions of the cranial contents has already been insisted upon. (*See* page 106.) When the cranial cavity is diminished in size by an effusion of blood or other slowly-progressing cause, the safety-valve action of the cerebro-spinal fluid diminishes the resulting rise of pressure to a certain extent. Beyond this point each increment of pressure tells directly upon the cranial contents, and the first part to be affected is the vascular system.

Symptoms of compression.—The symptoms of compression of the brain vary considerably according to the situation, extent, and nature of the injury. There are certain features common to all cases of compression, and as it is of the utmost importance that the condition should be recognised, the symptoms of a typical case will be described. We will suppose that, as is usually the case, the compression sets in gradually, taking several hours to reach its maximum; compression of such a nature is well seen in a case of hæmorrhage from the middle meningeal artery.

Consciousness.—Headache, gradually increasing in intensity and accompanied by drowsiness, is nearly always present. The drowsiness increases, and a condition of greater or less insensibility is reached, passing finally into absolute coma. The degree of insensibility varies according to the amount of compression. In moderate degrees of compression it is possible to rouse the patient by shaking or by pricking him. In more severe compression insensibility may be complete.

Circulatory system.—In moderate compression the blood pressure is increased and the heart is slowed; hence the slow, full, and heaving pulse so characteristic of cerebral compression. In severe compression the blood pressure is low and the heart beats rapidly; hence the pulse becomes rapid and irregular, both in force and rhythm. The slow pulse, therefore, is characteristic only of a certain degree of compression, and is not present in grave cases.

The explanation of these effects on the circulatory system seems to be this: as the intra-cranial pressure increases and causes an anæmia of the medulla oblongata, the cardio-inhibitory and vaso-motor centres are stimulated, and so a slow, full, and heaving pulse is produced. After a time these centres become exhausted and the heart muscle fatigued, so that a rapid, weak, and irregular pulse is produced.

Respiratory system.—As in the case of the circulatory system, we find the character of the respiration alters as the compression increases, and the same explanation holds good as regards the respiratory centre.

In moderate compression the respirations are regular, slow, and deep, owing to stimulation of the respiratory centre. In severe compression they become rapid and irregular, both in force and rhythm, almost approaching the Cheyne-Stokes type of respiration. Death takes place by cessation of respiration. By performing artificial respiration, the pulse may continue for minutes or even hours after spontaneous breathing has ceased.

Motor system.—If the compression occurs slowly, convulsions are usually absent; only in cases where the intra-cranial pressure is suddenly raised are convulsions met with; in cases of uncomplicated compression met with in surgical practice, convulsions are rare. The usual effect on the motor system is progressive paralysis of the voluntary muscles. Inasmuch as the compressing agent is generally exerting more pressure on one side of the brain than on the other, hemiplegia is usually present for a time. As the general intra-cranial pressure increases, the muscles of the other side become paralysed, and there is general motor paralysis. It is at this stage that the respirations become accompanied by the characteristic stertor and blowing out of the cheeks and lips. These are signs of paralysis of the soft palate, buccinator, and lip muscles.

In cases where the compressing agent is diffused from the first throughout the whole cranial cavity, the paralysis affects both sides of the body fairly equally.

In other cases where the compressing agent is small and exerting

a localised pressure over a part of one motor region, a paralysis of the corresponding group of muscles may be present alone.

Sensory system.—In early compression the patient may feel cutaneous stimuli, but, later, insensibility is complete.

Reflexes.—As the compression increases, the superficial and deep reflexes gradually disappear.

Pupils.—When the increase of cerebral pressure is general, both pupils are affected equally. They first of all contract, and as the compression increases they become dilated and immobile, not reacting to light.

As a rule the compressing agent affects one side of the brain more than the other. In these cases the pupil on the same side as

the compressing agent at first contracts, and later begins to dilate until it becomes widely dilated and immobile. This condition of the pupil—namely, a widely-dilated and immobile pupil—has been described by Hutchinson in lesions of the brain on the same side. As the intra-cranial pressure rises, the opposite pupil goes through the same changes, until finally both pupils are equal and widely dilated.

The following diagram will show the condition of the pupils as the compression gradually increases (Fig. 546).

	Right.	Left.
Pupils equal	○	○
„ unequal	○	●
„ „	○	○
„ „	○	○
„ „	○	○
„ „	○	○
„ „	○	○
„ „	○	○
„ equal	○	○

Fig. 546.—Left Cerebral Hemisphere Compressed.

Rectum and bladder.—The sphincters, both of the bladder and rectum, are paralysed. The rectum itself is not paralysed, hence there is incontinence of faeces, unless the patient was constipated before the accident. The bladder, on the other hand, is paralysed, so that

it cannot expel the urine. Hence there is retention of urine until the bladder is distended, and then the urine dribbles away.

Temperature.—At first the temperature is subnormal, but as the pressure increases the temperature usually rises, so that in fatal cases there is frequently hyperpyrexia. When the compressing agent is diffused there is no difference in the surface temperature, but when one hemisphere is compressed more than the other, the surface temperature of the side of the body opposite to the lesion—i.e. the side first paralysed—is raised a variable amount (2° to 1° F.). A peculiar reversal of this difference of the surface temperature occasionally takes place in very severe compression, so that the surface temperature of the side opposite to the lesion is lower than that of the same side.

As a rule, however, the surface temperature of the side first paralysed—i.e. of the side opposite to the lesion—is distinctly raised.

Differential diagnosis of compression and concussion.

—To the beginner the diagnosis of compression and concussion of the brain is often a matter of great difficulty. This arises from the fact that the essential distinction between the two conditions is not thoroughly understood, and the attention is concentrated too intently upon such varying symptoms as the condition of the pulse and respiration and the degree of consciousness. In the account of compression it has already been pointed out that the *pulse* varies enormously in character, according to the amount of compression exerted upon the brain. The slow, regular, and heaving pulse so characteristic of the early stages of compression is succeeded by a rapid, weak, and irregular pulse, such as one may sometimes get in concussion. If, therefore, too much stress is laid upon the character of the pulse, sooner or later confusion is certain to arise. Then again, as regards *consciousness*, it is frequently stated that the patient can be aroused by speaking loudly in concussion, but that in compression there is no response. We must remember, however, that in severe concussion we may be totally unable to rouse the patient, whereas in moderate degrees of compression the patient may respond readily.

The most important difference lies in the condition of the *muscular system*. In concussion the muscles are more or less flaccid, and inasmuch as they are not moved, they may be said to be paralysed. This paralysis, however, is nothing like so complete as in compression. As soon as consciousness returns the muscles can be used, showing the paralysis was a temporary and *functional* one. In compression, on the other hand, even if consciousness returned, the patient would be unable to contract the muscles so long as the compressing agent was present. The paralysis may therefore be said to be *organic*. That the effect upon the muscular system in compression is much more profound than in concussion is seen in several ways. The loss of tone in the muscles is greater; this is especially seen in the stertor, showing loss of tonicity in the muscles of the palate, and in the blowing out of the cheeks during expiration, showing loss of tonicity of the muscles of the cheek and mouth. This great loss of tonicity probably depends upon the fact that the spinal centres are inhibited by the increased pressure, and the same explanation will account for the abolition of the reflex act of micturition described as occurring in compression—*i.e.* retention of urine, followed by overflow.

In earlier stages of compression the recognition of muscular paralysis is very easy. On comparing the two sides of the body the difference of tonicity is readily recognised. This is especially the case in the face, where a slight irregularity in the action of the muscles produces an alteration in the expression. In the later stages of compression, when muscular paralysis has become general, this loss of tonicity may not be so easy to recognise. At this stage the best indication is the stertor and blowing out of the cheeks during expiration.

The way in which the *bladder* and *rectum* are affected may aid

us in the diagnosis. In both cases the sphincters are relaxed. In concussion neither the bladder nor the rectum is paralysed, so that the reflex acts of micturition and defæcation take place even more readily than normal, owing to the relaxation of the sphincters. In compression, on the other hand, the spinal centres controlling the bladder are inhibited, and therefore the reflex act of micturition cannot take place. The bladder fills with urine to a certain point, and then overflow takes place.

The rectum is not readily paralysed in compression, and unless the fæces are too dry, defæcation may take place unconsciously.

The condition of the *pupils* may aid us considerably. In pure uncomplicated concussion the pupils are either not affected, or are more or less dilated equally on the two sides; they react to light, except in very extreme concussion. In compression the pupils are unequal during the progress of the compression, and it is only in the final stage that we find the pupils are equal and widely dilated, with no reaction to light.

The *surface temperature* on the two sides of the body is identical in concussion, but usually unequal in compression.

DIFFERENTIAL DIAGNOSIS OF CONCUSSION AND COMPRESSION.

	<i>Concussion.</i>	<i>Compression.</i>
1. Relation of onset of symptoms to the injury.	Always immediately after the injury.	Usually some hours after the injury.
2. Mode of onset of symptoms.	Always sudden.	Headache and drowsiness, gradually passing to unconsciousness.
3. Condition of muscular system.	General relaxation, but no profound paralysis.	Definite paralysis : a. Localised to one group of muscles or to one side of body (readily recognised). b. General paralysis (recognised by stertor and puffing out of cheeks during expiration).
4. Pulse.	Always weak, usually slow, occasionally rapid and irregular.	a. In early stages, slow, regular, and heaving. b. In later stages, rapid, irregular, and weak.
5. Respiration.	Always slow and shallow, occasionally sighing.	a. In early stages, regular, deep, and slow. b. In later stages, irregular in force and rhythm approaching Cheyne-Stokes' type.
6. Bladder.	Incontinence of urine.	Retention + overflow.
7. Pupils.	Equal and dilated. React to light.	Unequal until last stage, when equal, widely dilated, and no reaction to light.
8. Surface temperature.	Equal on the two sides.	Usually unequal.

The differential diagnosis of coma from head injuries and other causes.—The surgeon is often called to see a patient who is in a condition of coma—*i.e.* a state of more or less complete insensibility—and it is most important, both from the point of view of treatment as well as in the medico-legal aspect, that he should be able to decide whether the patient is suffering from the effects of a head injury, or from a poisonous dose of a drug, or from some disease of the nervous system.

Coma is very liable to develop during the course of certain diseases—*e.g.* epilepsy, meningitis, tumours of the brain, renal disease (uræmia), diabetes, etc. As a rule, the existence of the disease is easily obtained from the friends, and the question of injury is seldom raised. In some cases of uræmia, however, there may be considerable difficulty in the diagnosis from head injuries. The existence of chronic renal disease may have been unknown, not only to the friends, but also to the patient, and the sudden development of uræmic coma in the street might lead to the patient being found in an unconscious condition, in circumstances that would be suggestive of head injury. Excluding these cases, which may be termed secondary coma, there remain the following causes:—

1. Injuries to the head.
2. Alcoholic and narcotic poisoning.
3. Cerebral hæmorrhage, embolism, and thrombosis.
4. Heat-stroke.
5. Exposure to cold.

In many cases the injury to the head is so obvious, or the evidence of some injury is so clear, that no difficulty arises. The most troublesome cases of all are those where people are found in the street in a comatose condition, with a strong alcoholic odour of the breath. The coma might be due to a poisonous dose of alcohol, but very often the fact that the patient has been drinking has had little or nothing to do with the production of the insensibility. Thus a drunken man may receive a severe blow, or may fall on to the head and become unconscious, owing to grave intra-cranial mischief. In other cases the fit of drunkenness may determine the occurrence of cerebral hæmorrhage or thrombosis. To make a diagnosis in such cases, at a moment's notice, is often impossible.

It is therefore a most important rule *never to decide at once in doubtful cases of this nature, but to keep the patient in bed under close observation for at least twenty-four hours.*

If narcotic poisoning be suspected, great care should be taken to discover traces of the drug in the surroundings of the patient, in the vomit, or in the contents of the stomach, obtained by means of a stomach-pump. The absolute coma, pin-point pupils, weak and frequently irregular pulse, and the lividity of the face, are generally characteristic, and such a case is more likely to be mistaken for hæmorrhage into the pons varolii rather than for injury to the head.

In coma from heat-stroke or prolonged exposure to cold the

history of the case and the conditions under which the patient is found are usually sufficient.

The diagnosis of coma from cerebral hæmorrhage, embolism or thrombosis can only be made after carefully excluding injury and the other causes of coma.

The diagnosis of the situation of the compressing agent.—If the symptoms of compression can be definitely traced to an injury, the question arises: Where is the compressing body situated? The first thing is to decide, if possible, which side of the brain is affected. In this endeavour we may be assisted by the following points:—

(a) The head should be carefully examined with a view to discovering the existence of any wound or bruise of the scalp, or any depressed fracture of the skull. It must be remembered that the injury to the brain may be on the opposite side to the injury of the scalp or skull—i.e. contusion or laceration of the brain by *contre-coup*.

(b) Any inequality in the condition of the muscles of the two sides must be noted. Thus rigidity or clonic spasms of one group of muscles or of the muscles of one side of the body would indicate that the lesion is on the opposite side of the brain. Any increase in the flaccidity of the muscles of the two sides, especially of the face muscles, should be noted.

(c) The condition of the pupils may help us considerably; remember that a widely-dilated pupil on one side points to a lesion of the brain on that side.

(d) Occasionally the surface-temperature of the two sides of the body may assist us; this is especially the case when the temperature of one side is distinctly higher than that of the other, and indicates a lesion on the opposite side of the brain.

Having determined which side of the brain is exposed to the increased pressure, we must next determine the part of the hemisphere that is chiefly affected. This can only be done by carefully noting the muscles affected with clonic spasms or rigidity, and by watching the onset of definite paralysis. A reference to the distribution of functions in the sensori-motor area, which has been already fully described, will then aid us in localising the lesion.

Edema of the brain.—When a foreign body is introduced into the cranial cavity the general cerebro-spinal pressure is raised, as well as the direct pressure exerted by the body upon the area of brain compressed. After a time, by absorption of cerebro-spinal fluid, this increase of the general pressure may become much less, and when the compressing agent is small, it may even disappear. The symptoms that follow are due, therefore, to the interference with the brain tissue at and around the compressing agent. Bergmann and the majority of authors maintain that the symptoms produced are due to anæmia of the brain. In order to obtain definite proof on this point a series of experiments were carried out by the author on monkeys in order to determine the changes in the circulatory

mechanism of the region of the brain affected by the compressing agent. The animals were anæsthetised with ether, and strict anti-septic precautions were taken during the experiments. The bone over the parietal area was laid bare, and a disc of bone was removed from the skull with a trephine, in all cases over a corresponding portion of the motor area. A glass disc was then gradually pressed into the trephine hole, until it was just below the level of the skull. It was then slipped gently between the dura mater and the convolutions, so that it could not project from the trephine hole. The dura mater was then sutured with fine silk, and the wound sewn up with horsehair. In no case was any sign of unhealthy processes found in the wound, which healed perfectly by first intention. There is produced in this way a very evident anæmia of the compressed area, which can always be seen through the glass disc. On analysing the brain substance from the neighbourhood of the compressed region, and comparing it with that from a corresponding point of the opposite hemisphere, it was found that there was a considerable excess of fluid around the compressed tissue. By numerous quantitative experiments, the existence of an oedematous condition around the compressing agent was definitely proved.

The formation of this œdema may probably be explained in the following way: The brain substance in immediate contact with the disc is, as we have just seen, anæmic, owing to the fact that the pressure exerted by the disc partially or completely empties the vessels. From this anæmic area the pressure gradually diminishes, until a zone is reached where the veins and lymphatics are quite or nearly obliterated, but where the capillaries and small arterioles are still filled with blood. It is evident that this will lead to an exudation of serum from the capillary area supplying the veins and lymphatics.

The exudation thus poured out will cause still greater pressure on the vessels, and will, therefore, lead to more exudation; the increased œdema thus produced will exert pressure on the vessels over a still wider area, until the œdema may spread for an indefinite distance from the spot compressed. Owing to the peculiar anatomical conditions of the brain, situated as it is in an almost inextensible cavity, when an œdema has once commenced, a *circulus vitiosus* is established, leading to a progressive increase in the œdema. This form of œdema, therefore, arises from some obstruction to the outflow of blood from an area of the brain, and it may be termed a *passive* or *congestive œdema*.

An œdema may arise, however, when there is an increased flow of blood to the cerebral vessels leading to their distension, or the cerebral vessels may, from some cause or other, become relaxed or paralysed, and so become distended with blood. This will lead to an œdema which may tend to spread in a manner similar to that produced when the outflow is obstructed. It may be termed an *active œdema*. This spreading œdema, commencing around a compressing agent, will, in all probability, explain

the sudden onset of severe symptoms in cases of cerebral tumours which we know must have existed in the cranial cavity for months or years, and which must have increased in size very slowly. Such a tumour may produce very slight or no symptoms for some time, and then quite suddenly severe symptoms of cerebral compression may set in and the case terminate rapidly in coma and death. The explanation seems to be that for some time the tumour can grow without giving rise to any circulatory disturbance, but at last the adjacent veins and lymphatics become quite or nearly obliterated, and so an œdema arises which, as we have seen above, tends to spread indefinitely.

It is highly probable that this spreading œdema, whether of the active or passive variety, is the cause of certain symptoms occurring after head injury. For example, the onset of coma during the reaction stage of concussion, coming on within forty-eight hours of the injury, is, in all probability, due to a hyperæmia of the cerebral vessels leading to the active variety of the spreading œdema. Again, the progressive loss of consciousness and increasing paralysis following lacerations or contusions of the brain are probably to be explained in the same manner. Cases in which convulsions commence two or three days after a head injury, and in which there is no reason to suspect septic meningo-encephalitis, are probably explained by the occurrence of an œdema spreading from a localised contusion or laceration of the cerebral cortex. Many cases of so-called acute, sub-acute, or even chronic encephalitis following head injuries which tend to recover are not, probably, of the nature of true inflammation like the septic complications, but are more satisfactorily explained by the theory of spreading œdema. The *symptoms* of this condition are not very characteristic. They consist in progressive paralysis and insensibility passing into absolute coma, with a raised temperature and sometimes hyperpyrexia. The pulse is weak and rapid, and never exhibits the full and heaving character met with in cerebral compression. (*See* page 113.)

The causes of compression after injury.—Compression of the brain, as a result of injuries to the head, may be due to the following causes:—

1. Effusion of blood into the cranial cavity.—The hæmorrhage may take place in various situations, such as—

- (a) Between the skull and dura mater—*subcranial* hæmorrhage.
- (b) Beneath the dura mater with or without rupture of the arachnoid—*subdural* and *subarachnoid* hæmorrhage.
- (c) Into the substance of the brain—*intra-cerebral* hæmorrhage.
- (d) Into the ventricles of the brain—*intra-ventricular* hæmorrhage.

2. Inflammatory effusions.—These may be—

- (a) *General*, as in septic lepto-meningitis.
- (b) *Local*, as in abscess.

3. Depressed fractures.

4. Foreign bodies.

We will now proceed to consider two important causes of compression of the brain—namely, effusion of blood and of inflammatory exudation.

1. **Effusion of blood into the cranial cavity.**—There are different situations in which the hæmorrhage may take place.



Fig. 547.—Rupture of Middle Meningeal Artery of the left Side in a case of fractured Skull. The blood-clot is lying between the dura mater and the bone. (Hutchinson.)

(a) *Subcranial*.—In these cases the blood is usually strictly limited by the bone externally and the dura mater internally. Sometimes, however, the blood may escape through a fissured fracture in the bone and so become *extra-cranial*. In other cases the dura mater may be ruptured and the hæmorrhage become *subdural* as well as subcranial. The most common source of blood in subcranial hæmorrhage is the middle meningeal artery (Fig. 547). It is difficult to obtain anything like accurate statistics on such matters, but 75 per cent. would probably be near the mark. The hæmorrhage is usually from the anterior branch. The posterior branch is wounded in only about 5 to 10 per cent.

hæmorrhage. The symptoms of compression as they occur in these cases are so typical that the description on page 112 accurately expresses the condition.

The lucid interval between the symptoms of concussion and the onset of symptoms of compression is very variable in duration. It is usually a few hours, but may be as long as two or three days. In the latter cases it is unlikely that the hæmorrhage is continually taking place. In all probability the hæmorrhage is at first slight, and ceases; and later, owing to an increased blood-pressure from exertion or other cause, the hæmorrhage starts again, and does not stop.

Diagnosis.—Concussion of the brain, with partial or complete return of consciousness, strongly suggests subcranial hæmorrhage. If, in addition, there is evidence of fracture in the temporo-parietal region, such as fulness in the temporal fossa, etc., together with paralysis of the opposite side of the body, the hæmorrhage is more likely to have taken place from the anterior branch of the middle meningeal than from the posterior branch or from the cranial sinuses.

It is in these cases of subcranial hæmorrhage that one is likely to meet with a widely dilated pupil on the same side as the lesion, described on page .

When the posterior branch of the middle meningeal or the cranial sinuses are wounded hemiplegia is not usually present.

Prognosis.—If the amount of blood effused be slight, recovery may gradually take place, usually with more or less permanent hæmiplegia.

If the clot is a large one, and progressively increases, the patient dies from the effects of compression of the brain—i.e. cessation of respiration. Some cases die, not from symptoms of ordinary compression, but with a rapid and weak pulse and hyperpyrexia. These symptoms are probably due to a spreading œdema, described on page 119.

Treatment.—If there be any scalp wound, this must be carefully examined, to see if there be any fissured fracture of the skull, and especially to see if any blood oozes through the fissure. In such an event the trephine should be applied at a spot where the fissure crosses the line of the middle meningeal artery.

If there be no external wound and the symptoms point to hæmorrhage from the middle meningeal artery, the following operation should be performed :—

The head having been shaved and rendered aseptic, the line of the anterior branch of the middle meningeal should be mapped out. Draw Reid's base line A B (Fig. 548), and draw a line c D backwards from the external angular process of the frontal bone parallel with the base line. Along this line measure off distances of $1, 1\frac{1}{2}, 2,$ and $2\frac{1}{2}$ inches. Through these points draw lines at right angles to Reid's line from the upper border of the zygoma. Measure the same distance up these lines that they are distant from the external angular process of the frontal bone. By joining these points the

et-mortem, it is found, that in many of these cases the brain has expanded again, whereas in others it has remained in its compressed condition.

From experiments performed on monkeys by the writer it was found that, after removal of the compressing agent, in nearly all cases the brain substance returned to its normal level. On cutting thick sections of the hardened brain for examination with the naked eye, it was found that in the deep parts of the cortical grey matter, and especially in the white substance immediately underneath, a great deal of blood had been effused, and several clots were found which had destroyed small areas of brain substance. If, on the other hand, brains which have been hardened with the compressing agent *in situ* are examined, no such extensive hæmorrhages are found.

It is evident that the hæmorrhages into the brain substance are due to blood being pumped into vessels that have been temporarily deprived of blood, and that have been injured by the pressure of the compressing agent. The blood escapes through the injured walls of the vessels, and the usual inflammatory reaction, which takes place when blood is pumped through vessels that have been empty for some time, follows. The œdema thus produced may spread in the manner described by Bergmann, and so lead to extensive cerebral mischief. Some disastrous results I have seen in two animals from which one of the large discs was removed. In each case the animal was progressing well while the disc was compressing the brain, but both animals died within eighteen hours after the removal of the discs. This is probably the manner in which many fatal cases of meningeal hæmorrhage after operation occur in surgical practice. The symptoms that arise in these cases after operation are not those characteristic of cerebral compression, but seem rather to consist in progressive weakness and insensibility, accompanied by fever, and occasionally perpyrexia, and death within twenty-four hours. The spreading œdema caused by the pressure of the clot, and the further œdema produced by the hyperæmia after removal of the clot, tend to progress, and finally produce death.

In some cases the brain does not expand again after removal of the clot, and the patient dies in a collapsed condition. The expansion that takes place after removal of the clot is due to the blood being forced into empty vessels, but this cannot take place unless the heart is beating forcibly enough to fill the empty vessels. If, therefore, as a result of the compression, the blood-pressure is reduced to so low an ebb that it cannot fill the empty vessels, it is not surprising that it cannot maintain the nutrition of the vital centres in the brain, and that death results. From a consideration of these points the following treatment for subcranial hæmorrhage is recommended.

The patient having been trephined in the usual way, the blood-clot should be moved from the surface of the dura mater. If by these means the symptoms are relieved, and the patient continues to improve, no further steps need be taken; but if the

finding no clot on the surface, the blood might be found by inserting a small trochar.

If the presence of blood under the cortex was then determined, an incision should be made and the clot evacuated.

If hæmorrhage continued the vessel might be included with some brain tissue in a ligature (*see* page 104), or the bleeding cavity plugged with iodoform gauze.

2. Inflammatory effusions into the cranial cavity.—

In the literature of this subject there is a great deal of confusion in the nomenclature. The terms *encephalitis*—acute, subacute, and chronic—*arachnitis*, and *meningitis* are used in a vague and unsatisfactory manner. There is no doubt that, after an injury to the head, either with an apparent wound or not, micro-organisms may gain an entrance and set up inflammatory mischief. If the inflammation occurs in the brain alone it should be termed *encephalitis*; if in the meninges alone, *meningitis*; and if, as is usually the case, both the meninges and brain be affected, the term *meningo-encephalitis* should be employed.

If the symptoms progress rapidly, and death terminates within a fortnight, the case may be called an acute one. If the fatal termination occurs within a month, it may be termed subacute. Cases of a duration longer than one month may be looked upon as chronic. It is the custom of some writers, however, to speak of chronic *encephalitis*, although the symptoms may be very acute, and terminate fatally in a few days. By them the term chronic is used, because the interval between the infliction of the injury and the onset of the inflammation is a long one. That such a long interval may supervene is owing to the fact that the micro-organisms which actually start the inflammation reach the brain by a very indirect path. When they once reach the brain, however, the inflammation may be most acute, and cause death with terrible rapidity.

Sometimes most grave symptoms, from which the patient may recover, follow an injury to the head. These symptoms usually commence within a few hours, or a day or two of the injury, and there is no evidence that they are due to the invasion of micro-organisms. The term acute *encephalitis* is often used in these cases; but in all probability the symptoms are caused by a spreading œdema of the brain, quite independent of septic infection, of which œdema the mechanism has already been described. (*See* page 119.) Thus, when after concussion of the brain the patient becomes more and more comatose, and dies within two or three days, the fatal result is probably due, not to an acute *encephalitis*, but to a progressive œdema, which tends to spread indefinitely, and finally terminates life.

If we exclude these cases, it is highly probable that all inflammatory affections following head injuries are caused by the introduction, either directly or in various indirect ways, of septic micro-organisms. The resulting inflammation may be general or diffused, and localised or circumscribed.

the sudden onset of severe symptoms in cases of cerebral tumours which we know must have existed in the cranial cavity for months or years, and which must have increased in size very slowly. Such a tumour may produce very slight or no symptoms for some time, and then quite suddenly severe symptoms of cerebral compression may set in and the case terminate rapidly in coma and death. The explanation seems to be that for some time the tumour can grow without giving rise to any circulatory disturbance, but at last the adjacent veins and lymphatics become quite or nearly obliterated, and so an œdema arises which, as we have seen above, tends to spread indefinitely.

It is highly probable that this spreading œdema, whether of the active or passive variety, is the cause of certain symptoms occurring after head injury. For example, the onset of coma during the reaction stage of concussion, coming on within forty-eight hours of the injury, is, in all probability, due to a hyperæmia of the cerebral vessels leading to the active variety of the spreading œdema. Again, the progressive loss of consciousness and increasing paralysis following lacerations or contusions of the brain are probably to be explained in the same manner. Cases in which convulsions commence two or three days after a head injury, and in which there is no reason to suspect septic meningo-encephalitis, are probably explained by the occurrence of an œdema spreading from a localised contusion or laceration of the cerebral cortex. Many cases of so-called acute, sub-acute, or even chronic encephalitis following head injuries which tend to recover are not, probably, of the nature of true inflammation like the septic complications, but are more satisfactorily explained by the theory of spreading œdema. The *symptoms* of this condition are not very characteristic. They consist in progressive paralysis and insensibility passing into absolute coma, with a raised temperature and sometimes hyperpyrexia. The pulse is weak and rapid, and never exhibits the full and heaving character met with in cerebral compression. (See page 113.)

The causes of compression after injury.—Compression of the brain, as a result of injuries to the head, may be due to the following causes:—

1. Effusion of blood into the cranial cavity.—The hæmorrhage may take place in various situations, such as—

- (a) Between the skull and dura mater—*subcranial hæmorrhage*.
- (b) Beneath the dura mater with or without rupture of the arachnoid—*subdural* and *subarachnoid hæmorrhage*.
- (c) Into the substance of the brain—*intra-cerebral hæmorrhage*.
- (d) Into the ventricles of the brain—*intra-ventricular hæmorrhage*.

2. Inflammatory effusions.—These may be—

- (a) *General*, as in septic lepto-meningitis.
- (b) *Local*, as in abscess.

3. Depressed fractures.

4. Foreign bodies.

We will now proceed to consider two important causes of compression of the brain—namely, effusion of blood and of inflammatory exudation.

1. **Effusion of blood into the cranial cavity.**—There are different situations in which the hæmorrhage may take place.

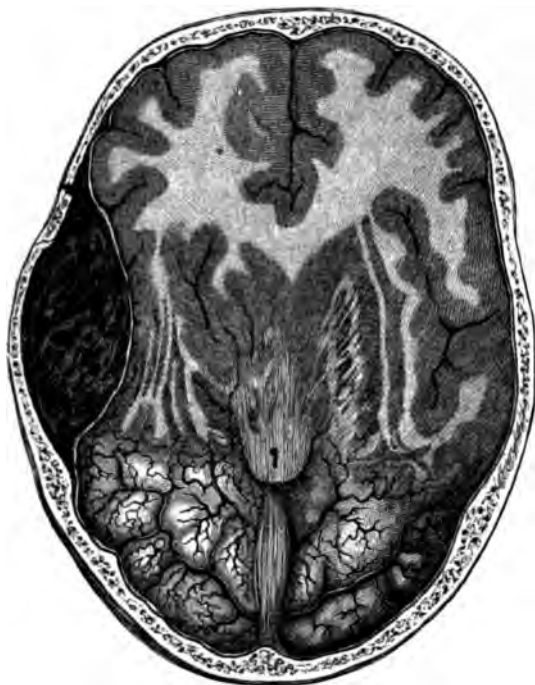


Fig. 547.—Rupture of Middle Meningeal Artery of the left Side in a case of fractured Skull. The blood-clot is lying between the dura mater and the bone. (Hutchinson.)

(a) *Subcranial.*—In these cases the blood is usually strictly limited by the bone externally and the dura mater internally. Sometimes, however, the blood may escape through a fissured fracture in the bone and so become *extra-cranial*. In other cases the dura mater may be ruptured and the hæmorrhage become *subdural* as well as subcranial. The most common source of blood in subcranial hæmorrhage is the middle meningeal artery (Fig. 547). It is difficult to obtain anything like accurate statistics on such matters, but 75 per cent. would probably be near the mark. The hæmorrhage is usually from the anterior branch. The posterior branch is wounded in only about 5 to 10 per cent.

Next in frequency to the middle meningeal artery are the three sinuses—the superior longitudinal, the lateral, and cavernous. Next in order come the veins of the diploë and the middle meningeal veins. Very rarely the internal carotid artery is wounded, either by a punctured wound or by a severe fracture of the base of the skull.

(b) *Subdural and subarachnoid.*—It is, of course, possible to find an effusion of blood between the dura mater and the arachnoid, or underneath the arachnoid without rupture of that membrane. In the majority of cases, however, the delicate arachnoidal membrane is ruptured, and the blood lies both in the subdural and subarachnoid spaces.

A subdural hæmorrhage, properly so called, would be caused by rupture of one of the sinuses of the dura mater on its internal aspect. In rare instances the trunk of the middle meningeal artery, just after it has entered the cranium by the foramen spinosum, is lacerated, together with the dura mater. Owing to the intimate attachment of the dura mater to the bone at that situation the blood escapes into the subdural space, and does not separate the dura mater from the bone.

A subarachnoid hæmorrhage may result from wounds in the vessels of the pia mater without any tear in the arachnoid. This is the true subarachnoid hæmorrhage. In cases where the cerebral veins are wounded the arachnoid is generally torn, and the resulting hæmorrhage is both subdural and subarachnoid.

Inasmuch as hæmorrhage in these two situations is so often combined and nearly always impossible to distinguish clinically, it is better to consider them together.

(c) *Intra-cerebral.*—Hæmorrhage from the vessels of the pia mater as they pass into the cortex of the brain is fairly common, and is present in most contusions and lacerations of the surface of the brain. On the other hand, hæmorrhage from the central vessels of the brain following injury are very rare.

(d) *Intra-ventricular.*—Occasionally, as the result of injury, there is hæmorrhage into the lateral ventricles. This may come from the vessels of the pia mater as they form the choroid plexuses, or may be due to a central vessel bursting through the corpus striatum or optic thalamus.

(a) **Subcranial hæmorrhage.** *Symptoms.*—An injury severe enough to cause rupture of the middle meningeal artery will certainly cause symptoms of concussion of the brain, which will immediately follow the injury. Owing to the firm adhesions between the dura mater and the bone and the weak heart-action caused by the concussion, the blood escapes very slowly from the torn vessel, so that, as a rule, the patient recovers, more or less completely, from the condition of concussion. As the effused blood increases in amount symptoms of compression appear and progressively increase. In fact, it would be impossible to devise an experiment to produce gradually increasing compression of the brain with greater simplicity and absence of disturbing factors than in these cases of subcranial

hæmorrhage. The symptoms of compression as they occur in these cases are so typical that the description on page 112 accurately expresses the condition.

The lucid interval between the symptoms of concussion and the onset of symptoms of compression is very variable in duration. It is usually a few hours, but may be as long as two or three days. In the latter cases it is unlikely that the hæmorrhage is continually taking place. In all probability the hæmorrhage is at first slight, and ceases; and later, owing to an increased blood-pressure from exertion or other cause, the hæmorrhage starts again, and does not stop.

Diagnosis.—Concussion of the brain, with partial or complete return of consciousness, strongly suggests subcranial hæmorrhage. If, in addition, there is evidence of fracture in the temporo-parietal region, such as fulness in the temporal fossa, etc., together with paralysis of the opposite side of the body, the hæmorrhage is more likely to have taken place from the anterior branch of the middle meningeal than from the posterior branch or from the cranial sinuses.

It is in these cases of subcranial hæmorrhage that one is likely to meet with a widely dilated pupil on the same side as the lesion, described on page .

When the posterior branch of the middle meningeal or the cranial sinuses are wounded hemiplegia is not usually present.

Prognosis.—If the amount of blood effused be slight, recovery may gradually take place, usually with more or less permanent hemiplegia.

If the clot is a large one, and progressively increases, the patient dies from the effects of compression of the brain—i.e. cessation of respiration. Some cases die, not from symptoms of ordinary compression, but with a rapid and weak pulse and hyperpyrexia. These symptoms are probably due to a spreading œdema, described on page 119.

Treatment.—If there be any scalp wound, this must be carefully examined, to see if there be any fissured fracture of the skull, and especially to see if any blood oozes through the fissure. In such an event the trephine should be applied at a spot where the fissure crosses the line of the middle meningeal artery.

If there be no external wound and the symptoms point to hæmorrhage from the middle meningeal artery, the following operation should be performed :—

The head having been shaved and rendered aseptic, the line of the anterior branch of the middle meningeal should be mapped out. Draw Reid's base line *A B* (Fig. 548), and draw a line *c d* backwards from the external angular process of the frontal bone parallel with the base line. Along this line measure off distances of 1, 1½, 2, and 2½ inches. Through these points draw lines at right angles to Reid's line from the upper border of the zygoma. Measure the same distance up these lines that they are distant from the external angular process of the frontal bone. By joining these points the

anterior branch of the middle meningeal is marked out for about 2 inches.

It is usually wounded as it lies in a deep groove or in a canal on the anterior inferior angle of the parietal bone, corresponding to a point $1\frac{1}{2}$ inch behind the external angular process and $1\frac{1}{2}$ inch above the zygoma. (See Fig. 548.)

A horseshoe-shaped flap of skin, with its base just above the

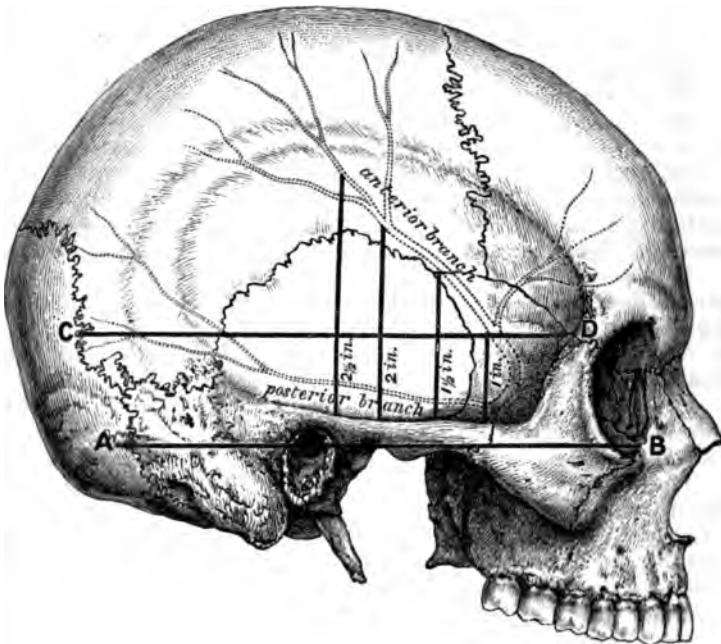


Fig. 548.—Showing a Method for finding the course of the anterior Branch of the middle meningeal Artery.

A B, Reid's base line; C D, a line drawn backwards from the external angular process of the frontal bone parallel with Reid's base line.

zygoma, and measuring 3 inches, is turned down, containing scalp and muscle.

If there be no fissured fracture to give any indication where to trephine, the point mentioned above should be taken and the trephine applied, the pericranium being previously turned back by a crucial incision.

If the artery be torn, on removing the disc of bone a blood-clot would be found, and this should be removed by a Volckman's spoon. The dura mater should then be sutured, the disc of bone replaced, and the wound sewn up.

On several occasions, although this operation has been performed and the vessel secured with success, the patient has died.

Post-mortem, it is found, that in many of these cases the brain has expanded again, whereas in others it has remained in its compressed condition.

From experiments performed on monkeys by the writer it was found that, after removal of the compressing agent, in nearly all cases the brain substance returned to its normal level. On cutting thick sections of the hardened brain for examination with the naked eye, it was found that in the deep parts of the cortical grey matter, and especially in the white substance immediately underneath, a great deal of blood had been effused, and several clots were found which had destroyed small areas of brain substance. If, on the other hand, brains which have been hardened with the compressing agent *in situ* be examined, no such extensive hæmorrhages are found.

It is evident that the hæmorrhages into the brain substance are due to blood being pumped into vessels that have been temporarily deprived of blood, and that have been injured by the pressure of the compressing agent. The blood escapes through the injured walls of the vessels, and the usual inflammatory reaction, which takes place when blood is pumped through vessels that have been empty for some time, follows. The œdema thus produced may spread in the manner described by Bergmann, and so lead to extensive cerebral mischief. These disastrous results I have seen in two animals from which one of the large discs was removed. In each case the animal was progressing well while the disc was compressing the brain, but both animals died within eighteen hours after the removal of the discs. This is probably the manner in which many fatal cases of meningeal hæmorrhage after operation occur in surgical practice. The symptoms that arise in these cases after operation are not those characteristic of cerebral compression, but seem rather to consist in progressive weakness and insensibility, accompanied by fever, and occasionally hyperpyrexia, and death within twenty-four hours. The spreading œdema caused by the pressure of the clot, and the further œdema produced by the hyperæmia after removal of the clot, tend to progress, and finally produce death.

In some cases the brain does not expand again after removal of the clot, and the patient dies in a collapsed condition. The expansion that takes place after removal of the clot is due to the blood being forced into empty vessels, but this cannot take place unless the heart is beating forcibly enough to fill the empty vessels. If, therefore, as a result of the compression, the blood-pressure is reduced to so low an ebb that it cannot fill the empty vessels, it is not surprising that it cannot maintain the nutrition of the vital centres in the brain, and that death results. From a consideration of these points the following treatment for subcranial hæmorrhage is recommended.

The patient having been trephined in the usual way, the blood-clot should be moved from the surface of the dura mater. If by these means the symptoms are relieved, and the patient continues to improve, no further steps need be taken; but if the

patient does not rally, the dura mater and arachnoid should be freely incised, and the œdematous brain allowed to bulge through the trephine-hole. If the bulging be considerable, a deep incision should be made into the protruding mass in order to relieve the tension caused by the œdema. As the œdema subsides the brain will return within the trephine-hole.

As a rule stimulants are not administered after operations for cerebral compression, because they tend to raise the blood-pressure and so produce a passive expansion of the cerebral vessels. In cases, however, where the brain substance does not expand after removal of the compressing agent this rule does not apply. The non-expansion of the brain is probably due, as we have already seen, to cardiac failure and therefore every endeavour should be made in such cases to stimulate the heart.

(b) **Subdural and subarachnoid hæmorrhage.** *Symptoms.*—In these cases the blood is poured out very rapidly. There is not the great resistance to the effusion of blood that we find in subcranial hæmorrhage, so that the symptoms of compression follow rapidly the symptoms of concussion. As a rule, therefore, in these cases the lucid interval is absent. The symptoms of concussion merge into those of compression, and as a rule there is more or less laceration of the brain. The blood-clot does not tend to become so large as in subcranial hæmorrhage, because the wounded vessels are much smaller, and are soon sealed by the clotting blood.

Diagnosis.—Symptoms of concussion, followed by gradually-increasing compression without any recovery of consciousness, would suggest that the blood is subdural rather than subcranial. The localisation of the blood-clot would be made by carefully observing the onset of spasm, rigidity, or paralysis of muscles.

Prognosis.—This depends on the amount of blood effused—i.e. the degree of compression—and upon any laceration of the brain that may accompany it.

Treatment.—If the symptoms of cerebral compression gradually progress no time should be lost, but the operation of trephining at once performed. The pin of the trephine should be applied over that spot where the symptoms point to the greatest pressure, or where the symptoms of local pressure first appeared. The dura mater will bulge considerably into the trephine-hole, and will present a dark blue or blue-black appearance. It should be incised and the clot removed by Volckman's spoon or other suitable instrument. If hæmorrhage continue, and efforts to secure the wounded vessel be unsuccessful, the bleeding spot should be plugged with iodoform gauze.

(c) **Intra-cerebral** and (d) **intra-ventricular hæmorrhages.**—This is very rare as a result of head injuries, if we exclude extensive lacerations.

The latter would probably be rapidly fatal; coma supervening early. Intra-cerebral hæmorrhage could not be diagnosed from subdural and subarachnoid before operation. On trephining and

finding no clot on the surface, the blood might be found by inserting a small trochar.

If the presence of blood under the cortex was then determined, an incision should be made and the clot evacuated.

If hæmorrhage continued the vessel might be included with some brain tissue in a ligature (*see* page 104), or the bleeding cavity plugged with iodoform gauze.

2. Inflammatory effusions into the cranial cavity.—

In the literature of this subject there is a great deal of confusion in the nomenclature. The terms *encephalitis*—acute, subacute, and chronic—*arachnitis*, and *meningitis* are used in a vague and unsatisfactory manner. There is no doubt that, after an injury to the head, either with an apparent wound or not, micro-organisms may gain an entrance and set up inflammatory mischief. If the inflammation occurs in the brain alone it should be termed *encephalitis*; if in the meninges alone, *meningitis*; and if, as is usually the case, both the meninges and brain be affected, the term *meningo-encephalitis* should be employed.

If the symptoms progress rapidly, and death terminates within a fortnight, the case may be called an acute one. If the fatal termination occurs within a month, it may be termed subacute. Cases of a duration longer than one month may be looked upon as chronic. It is the custom of some writers, however, to speak of chronic *encephalitis*, although the symptoms may be very acute, and terminate fatally in a few days. By them the term chronic is used, because the interval between the infliction of the injury and the onset of the inflammation is a long one. That such a long interval may supervene is owing to the fact that the micro-organisms which actually start the inflammation reach the brain by a very indirect path. When they once reach the brain, however, the inflammation may be most acute, and cause death with terrible rapidity.

Sometimes most grave symptoms, from which the patient may recover, follow an injury to the head. These symptoms usually commence within a few hours, or a day or two of the injury, and there is no evidence that they are due to the invasion of micro-organisms. The term acute *encephalitis* is often used in these cases; but in all probability the symptoms are caused by a spreading œdema of the brain, quite independent of septic infection, of which œdema the mechanism has already been described. (*See* page 119.) Thus, when after concussion of the brain the patient becomes more and more comatose, and dies within two or three days, the fatal result is probably due, not to an acute *encephalitis*, but to a progressive œdema, which tends to spread indefinitely, and finally terminates life.

If we exclude these cases, it is highly probable that all inflammatory affections following head injuries are caused by the introduction, either directly or in various indirect ways, of septic micro-organisms. The resulting inflammation may be general or diffused, and localised or circumscribed.

The ordinary form of diffused inflammation is that affecting the arachnoid and pia mater, *lepto-meningitis*, as it is called.

Associated with this there is more or less inflammation of the brain tissue, commencing on the surface where the vessels enter from the pia mater, and gradually spreading inwards, so that lepto-meningitis and encephalitis are nearly always present together. When the inflammation remains localised there is a great tendency for the formation of an abscess. Thus pachymeningitis, or inflammation of the dura mater, is usually localised and leads to the formation of a subcranial abscess. Occasionally a lepto-meningitis may remain localised and form a subdural abscess. Finally, we may get localised collections of pus in the brain tissues, i.e. cerebral abscess. There is but little doubt that all the suppurative affections are due to the entrance of micro-organisms, and we will, therefore, consider their ætiology and pathology together.

Ætiology and pathology of septic inflammations of the brain and meninges.—It is obvious that, at the time of the injury, the septic matter may gain direct entrance to the meninges or the brain. This is well seen in compound fractures of the vault of the skull, in some fractures of the base of the skull, and in punctured wounds of the skull. In such cases the symptoms of intra-cranial inflammation appear early, usually from the third to the fifth day. In the case where the meninges are affected in this way it is termed *primary meningitis*.

In many cases, however, the micro-organisms reach the brain in an indirect manner. As the path by which they reach the brain may vary, so the time of onset of inflammatory symptoms may vary. A favourite time is two to three weeks after the injury, but several weeks or an indefinite time may elapse. When the meninges are invaded in this way it may be termed *secondary meningitis*.

The organisms may reach the cranial contents by the following paths:—

(1) By direct extension from a wound of the scalp or skull, or of both. The dura mater becomes involved, and the organisms may spread, causing either local lepto-meningitis and abscess in the brain, or a general lepto-meningitis.

(2) By entrance through the venous system, which may take place in one or two ways.

(a) By thrombosis spreading inwards through the emissary and diploic veins to the cranial sinuses, and then to the brain. The thrombus is progressively invaded by the organisms.

(b) The blocking of one or more veins may cause a reversal of the blood stream, and thus any micro-organisms may be swept from the clot into the vein—*reflex propagation*.

(3) By extension along the peri-vascular lymphatic sheaths of the arteries.

(4) By extension along lymphatics from the galea to the subdural space. This is probably the path by which the brain is invaded in erysipelas.

(5) By extension along perineural lymphatics which communicate with the subarachnoid space.

(6) A septic wound in the head may, as in any other part of the body, give rise to pyæmia, and either the meninges or the brain may be involved in metastatic deposits.

Diffused inflammation of the brain and meninges (traumatic meningo-encephalitis). *Pathology.*—Whatever may be the path by which the micro-organisms reach the brain and its membranes, the first change is intense hyperæmia, with punctiform hæmorrhages in the vascular pia mater. If the germs have entered along thrombosed veins, the inflammation will be most intense around those veins. The inflammatory exudation is poured into the subarachnoid space, and increases the amount of the cerebro-spinal fluid. At the same time the character of the cerebro-spinal fluid is altered. The inflammatory exudation is rich in albuminous bodies, which will coagulate when heated. At first the exudation may be quite clear, but it rapidly becomes turbid, owing to the presence of leucocytes, and later, of red blood corpuscles. Finally the exudation may become quite purulent, and flakes of lymph become deposited upon the pia mater and arachnoid. If the latter membrane be torn by the violence of the injury, the inflammation will extend widely in the subdural space.

As a result of the inflammatory effusion, the attachment of the pia mater to the cerebral cortex becomes loosened, and strips off easily. The changes in the brain itself are slight to the naked eye. It is softer than normal, and œdematous. Owing to the increase in the amount of fluid in the subarachnoid space, the intra-cranial pressure is raised, and so we find that the convolutions are flattened.

On microscopical examination the inflammatory process can be seen extending from the pia mater into the cortex, along the periarterial lymphatic sheaths.

Injuries to the skull usually affect either the base or the vault, and the resulting inflammation is generally more intense in the region of the injury. For example, in injuries to the vault the convexity of the brain becomes first infected with micro-organisms, and the inflammation commences there, and is most intense in that situation. It must be remembered, however, that the inflammation usually spreads to the whole of the meninges sooner or later. For clinical purposes, therefore, it is convenient to recognise a *meningitis of the convexity* and a *meningitis of the base*. These two forms of meningitis have many symptoms in common, and, therefore, they will be described together, and any differences that may exist will be mentioned afterwards.

Symptoms.—It is convenient to divide the course of the disease into three stages.

First stage: The onset.—This may be very similar to the onset of any acute specific febrile disease. There is headache, accompanied by fever, and the patient complains of feeling cold, may shiver, or may even have a rigor. Vomiting is a frequent symptom, but is not

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always present. This stage rapidly, in a period of time varying from a few hours to twenty-four, passes into the next.

Second stage: The stage of irritation.—The patient becomes extremely restless, and often delirious. The pain in the head becomes greater, causing the patient to groan, or even cry out. The patient cannot bear the light, and is very intolerant of noise. In the early part of this stage the pupils are generally equal, and are contracted, reacting with variable activity to light. Optic neuritis often commences at this period.

Convulsions are by no means constant in their presence. When they are present they vary remarkably both in their degree and in their distribution. They may be limited to one group of muscles, or may affect one side of the body, or there may be general convulsions. After each convulsion a certain amount of weakness is left in the muscles, and as the fits recur the weakness progressively increases. The patient becomes more and more drowsy, and finally becomes insensible. At this period the pupils begin to dilate, but not always synchronously, so that there may be inequality of the pupils for a time. Their reaction to light is slight or absent.

Third stage: The stage of paralysis.—If convulsions have been present they cease at this stage, and the muscles are paralysed. If there are no convulsions, the onset of the paralysis is gradual and is always present. This paralysis may at first affect only a group of muscles, or there may be hemiplegia. As the inflammation advances and the cerebral compression increases, the whole of the voluntary muscles become paralysed. The patient lies insensible and still, and, owing to the general muscular paralysis, the respirations are accompanied by stertor. (*See page 113.*) With the increase in the intra-cranial pressure the pupils become widely dilated on both sides, and do not react to light. This comatose condition continues for a variable time, and the patient dies, usually within a week of the onset of the disease.

The pulse is quick and full at first, but as the compression increases it may become slower. In the third stage it is generally very rapid and irregular, both in force and rhythm.

The respirations are regular and deep at first, but in the third stage they become superficial and irregular, and finally cease before the pulse.

The temperature varies in different cases. As a rule it is raised to 102° or 103° F., and continues to rise until the termination. Sometimes, however, the temperature is scarcely raised at all, or may even be subnormal.

Differences between meningitis of the convexity and meningitis of the base.—In basal meningitis (*a*) retraction of the head and rigidity of its extensor muscles come on early, and are fairly characteristic; (*b*) optic neuritis is more constant in its presence, is more intense, and comes on earlier; (*c*) squint from spasm, or paralysis of one or more of the ocular muscles is usually an early and characteristic symptom.

In convexity meningitis (a) convulsions come on earlier, and are more frequent; (b) the convulsions are more likely to be localised at first to definite groups of muscles.

Diagnosis.—The onset of the disease is so like that of acute specific fevers, that unless there are reasons for suspecting meningitis, its recognition in the first stage may be impossible. The symptoms of paralysis following a head injury, if due to compression, contusion, or laceration of the brain, would, as a rule, be noticed within a few hours of the accident; whereas the symptoms of paralysis, if due to meningitis, are seldom present before the third day.

In the stage of irritation the diagnosis from spreading œdema may be very difficult—in some cases impossible until definite convulsions or paralysis occur.

We have already seen that after some lacerations of the brain, symptoms of irritation or paralysis of muscles do not appear until the fourth or fifth day, and it was explained that in these cases an œdema spreading from the laceration was probably the cause of the symptoms. In such cases the diagnosis from meningitis would be very difficult at first. From pyæmia it would be diagnosed by the absence of metastatic abscesses and of the characteristic temperature with rigors.

In some cases of tuberculous meningitis a history of a fall on the head is given by the friends, so that one is led to suspect acute septic basal meningitis.

Prognosis.—It is very doubtful whether any case of septic meningo-encephalitis has ever recovered.

Treatment.—It is highly probable that no method of treatment yet adopted has saved an undoubted case of septic meningitis. Reputed cases of recovery have probably been due to hyperæmia and œdema following a head injury rather than true septic meningitis.

Inasmuch as patients with septic meningitis usually die as the direct result of cerebral compression, the question of trephining and draining the subarachnoid space naturally presents itself. The patient is exposed to two potent agents in septic meningitis, increased intra-cranial tension, and septic poisoning. If the former danger is lessened by trephining, the patient is more likely to withstand the effects of the septic process. For the methods of draining the subarachnoid space in such cases, the reader is referred to the Article on Diseases of the Brain (page 212).

Short of operation, various methods of treatment have been employed. The administration of salts of mercury in large quantities, extensive venesection, etc., have been tried. It is very doubtful if any success has been obtained in a case of undoubted septic meningitis.

Intra-cranial abscess.—Abscesses occasionally form after an injury to the head, and are met with in three regions—between the dura mater and the bone, *subcranial abscess*; between the dura mater and the surface of the brain, *subdural abscess*; and in the

substance of the brain, *cerebral abscess*. All these abscesses are caused by micro-organisms, and the paths by which they enter have already been described. (See page 128.)

Subcranial abscess.

(a) With scalp wound.—In most cases the injury has resulted in a definite wound involving the scalp and exposing the underlying bone. The bone may be fractured or may be simply bruised. In these cases there is direct entrance of micro-organisms into the bone or even on to the surface of the dura mater. As a result there is a septic osteitis which spreads inwards to the dura, and an abscess forms.

This process takes some time to lead to the formation of pus, and the wound of the scalp has very often healed by the time the abscess reveals its presence. From the inflamed bone a serous exudation may spread into the scalp and cause a localised œdematous

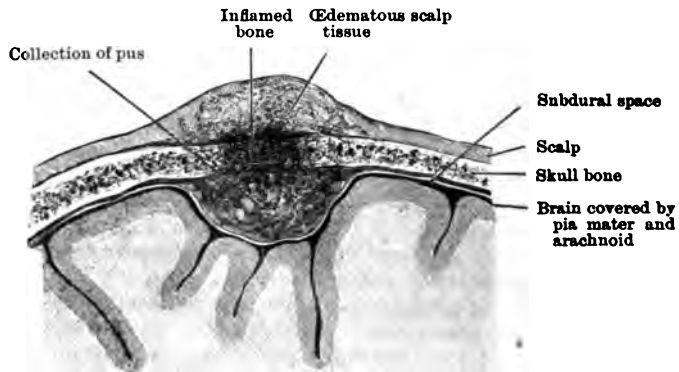


Fig. 549.—Semi-diagrammatic Figure showing a subcranial Abscess with œdema of the overlying Scalp (Pott's puffy tumour).

swelling, first described by Percival Pott, and termed by him "the puffy tumour." (See Fig. 549.)

(b) Without scalp wound.—In some cases a subcranial abscess may form without any apparent wound of the scalp. No doubt sometimes the septic material enters by small abrasions which are overlooked, and at other times the scalp tissue is crushed in its deeper layers, and any organisms lying in the hair follicles or sebaceous glands may readily gain entrance into the tissue and spread to the bruised bone. In either case the bone is bruised by the violence of the injury, and the diploic veins become thrombosed. As soon as the organisms reach the bone a septic osteitis commences, which results in the formation of an abscess on the outer surface of the dura mater and a serous exudation in the adjacent region of the scalp (Pott's puffy tumour).

Subdural abscess.—When the bone is fractured and the dura

mater torn, organisms may gain entrance to the surface of the brain and a local lepto-meningitis may result, passing on to the formation of pus, and so forming a subdural abscess. (See Fig. 550.) In other cases, from a septic wound of the scalp or a septic osteitis, the organisms may be carried through the dura mater and form a subdural instead of a subcranial abscess.

Cerebral abscess.—This is by no means a common result of injury to the head. It may follow the entrance of foreign bodies into the brain or a punctured wound, but it may occur after a severe blow upon the head, without any external wound. In these cases there is probably always a laceration or contusion of the brain substance, either on the side exposed to the violence or on the opposite side, as a result of *contre-coup*. The injured region of the brain becomes infected with organisms which are probably circulating in the blood, and so an abscess forms which in these cases is

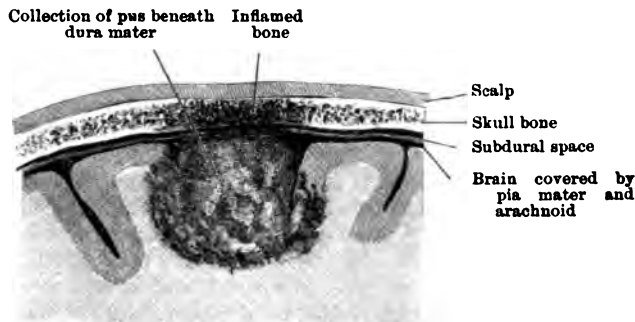


Fig. 550.—Semi-diagrammatic Figure showing a subdural Abscess extending into Brain Substance.

usually chronic. In nearly all cases traumatic abscess of the brain is single, and in the majority of cases is situated in the frontal or parietal regions on the same side as the injury.

The chief effect of intra-cranial suppuration is to cause symptoms of cerebral compression, and to save repetition the full discussion of traumatic abscess will be considered in the Article on DISEASES OF THE HEAD in connection with abscess of the brain (page 199).

CONTUSIONS AND WOUNDS OF THE SCALP.

Anatomy of the scalp.—There are certain peculiarities in the anatomy of the scalp which are of considerable practical importance in connection with injuries and diseases of that structure.

(1) The intimate attachment of the firm fatty and fibrous tissue of the scalp to the epicranial aponeurosis. For this reason wounds of the superficial part of the scalp do not gape, and a blow with a blunt object or a fall upon the head may produce a wound almost indistinguishable from an incised one.

(2) The loose attachment of the epicranial aponeurosis to, and its free movement upon, the pericranium. Hence, if this be divided the wound tends to gape considerably, or large pieces of the scalp may be torn away. It will also explain the ease with which the Indian "scalped" his victim. Again, if suppuration should occur beneath the epicranial aponeurosis it rapidly spreads, lifting up the scalp; and its extension is only limited by the attachments of the aponeurosis—namely, by the superciliary ridges and glabella in front, the superior curved line of the occipital bone behind, the base of the mastoid process and the zygoma laterally.

(3) The fact that the vessels are situated in that part of the scalp superficial to the epicranial aponeurosis is important. The scalp may be much lacerated, and flaps be turned down without any interference, or only slight interference, with its vascular supply. In suppuration beneath the epicranial aponeurosis, sloughing of the scalp seldom occurs to any extent, owing to the position of the vessels.

(4) The outer coat of the arteries in the scalp is firmly united to the fibrous tissue so that the vessels cannot retract well when divided, and owing to the rigidity of the fibrous tissue of the scalp they cannot easily be picked up by artery forceps. Hence scalp vessels bleed much when cut, and the hæmorrhage is not easily arrested.

(5) The pericranium is easily separated from the bone excepting at the sutures. It has very little to do in supplying the bone with blood, merely sending some small vessels to the outer table. Hence, when it is destroyed, the bone does not necessarily die. Any necrosis that ensues is quite superficial, and is due to an extension of a septic inflammation to the bone rather than the removal of the pericranium. Finally, the pericranium has not the function of producing new bone. To it cannot be attributed the osteogenetic function usually attributed to periosteum.

Contusions of the scalp.—These may be quite simple, being limited to the soft tissues, or there may be more or less injury to the underlying bone. Simple contusions are caused by falls upon the head, by blows, by spent projectiles, or by ricochetting bullets. Following the injury, more or less rapidly, a swelling forms, caused by the extravasation of blood. This swelling, usually termed a cephalhæmatoma, may be situated in different planes of the scalp.

(a) In that part of the scalp superficial to the epicranial aponeurosis—*subcutaneous cephalhæmatoma*.

(b) Between the epicranial aponeurosis and the pericranium—*subaponeurotic cephalhæmatoma*.

(c) Underneath the pericranium—*subperiosteal cephalhæmatoma*.

Extravasation in any of these situations may lead to the formation of a definite swelling, which has peculiar characters. The edge of the swelling feels very hard, sometimes like bone, and the centre is quite soft and may be slightly depressed. In fact, it may be mistaken for a depressed fracture. By firmly pressing on the edge of the tumour for a minute or two, it will be found that the raised

edge will gradually disappear, and the firm bone can be felt. This characteristic hæmatoma is most often met with when the vessels in the part of the scalp superficial to the epicranial aponeurosis are ruptured. Macewen's explanation of the formation of this peculiar tumour, with which my experience fully agrees, is that the central portion is the point which has been subjected to violent compression between the impinging body and the skull. In this part the cellular tissue has been broken up and scattered centrifugally, its elements, together with the neighbouring cellular tissue, causing a heaping up and condensation at the circumference, which now becomes more dense by the infiltration of blood. The soft, yielding central portion is due to the skin being separated from the epicranial aponeurosis by fluid blood.

Owing to the paucity of vessels beneath the epicranial aponeurosis a hæmatoma in that situation is rare. If blood is poured out in that situation it tends to become diffused owing to the slight attachment between the aponeurosis and the pericranium.

An extravasation of blood between the pericranium and the bone occurs, with very rare exceptions, only in new-born children. It is termed a *subperiosteal cepalhæmatoma*. It is more often met with in children who have been delivered by forceps. It is usually situated on the parietal bone, and tends to remain localised to that bone. It is occasionally met with on the occipital bone.

Diagnosis.—There is seldom any difficulty in the diagnosis. The history of an injury and the characteristic nature of the swelling with its soft central portion and the hard raised edge are usually sufficient. In the case of a subperiosteal cepalhæmatoma its limitation to one bone, usually the parietal, and the absence of any pulsation serve to distinguish it from meningocele.

Prognosis and treatment.—If left to themselves they nearly always gradually disappear. If, however, septic germs reach them and they suppurate, free incision, turning out clots, and drainage are necessary.

Wounds of the scalp.—As in other parts of the body, wounds of the scalp may be punctured, incised, contused, and lacerated. The wound may be quite superficial, not including the epicranial aponeurosis, as it may divide the aponeurosis. The pericranium may be wounded and the bone laid bare.

It has already been pointed out how the anatomical structure of the scalp confers certain peculiarities upon wounds inflicted upon it; the slight tendency for superficial wounds to gape and their tendency to appear incised although inflicted by blunt instruments. The fact that, when the epicranial aponeurosis is also wounded there is considerable gaping, and the ease with which large areas of the scalp may be torn away from the pericranium, have already been mentioned. Finally, the ease with which lacerated portions of scalp retain their vitality owing to the position of the vessels and the difficulty in controlling hæmorrhage from them have been already insisted upon.

Dangers of scalp wounds.—The immediate danger is that of hæmorrhage. Even though the wound be a small one, the amount of blood lost may be very great, especially if one of the arteries has only been partially divided.

The other dangers are due to infection by micro-organisms. In a complete wound of the scalp, if drainage is not free, pus accumulates beneath the epicranial aponeurosis and may spread widely, completely separating the scalp from the underlying bone, being limited by the curved line of the occipital bone behind, the base of the mastoid process and zygoma laterally, and the superciliary ridges and glabella in front.

The wound may become inoculated with the germ of cutaneous erysipelas, and this may spread to the face or even to the meninges.

Septic processes may extend to the bone and cranial contents as described on page 184.

Finally, as in wounds of other regions of the body, septicæmia or pyæmia may arise.

Treatment.—In most cases the application of moderate pressure is sufficient to stop the bleeding. If the vessel from which blood is coming is only partially divided it should be cut across so that the two ends may retract. If large vessels are spurting they should be picked up by artery forceps, or a ligature passed around them by Reverdin's needle. Spencer Wells' forceps are not suitable for picking up vessels in the scalp. Considerable trouble may be caused by wound of the deep temporal arteries. In these cases the tissues should be dissected until the wounded vessel is found. It can scarcely be justifiable, and, indeed, it is contrary to one of the fundamental rules of the treatment of primary hæmorrhage to tie the common or external carotid as suggested by some persons.

Having stopped any considerable hæmorrhage that may have taken place, the attention should next be directed to cleaning the wound and the surrounding area of the scalp. The scalp should be shaved for some considerable distance around the wound. In a large wound, especially if the epicranial aponeurosis be divided, the whole, or nearly the whole, scalp should be shaved.

By antiseptic solutions (1 in 20 carb. acid; 1 in 2,000 hyd. perchlor.) the wound and scalp should be rendered as aseptic as possible.

The wound should then be sutured by silkworm gut, care being taken, in all cases, to drain the wound for forty-eight hours. If at the end of that time no suppuration should have occurred, the tube may be removed. No wound of the scalp, unless inflicted under conditions of asepsis, should be tightly sewn up without a provision for drainage.

In very extensive wounds, in which large flaps of lacerated scalp are turned down, every effort should be made to replace the flap, and to keep it in position by sutures or by strapping, or by firm bandaging. Even if suppuration should set in, these wounds do remarkably well if drainage is thoroughly carried out.

In all wounds of the scalp an aseptic or antiseptic dressing should be applied and bandaged with firm pressure.

CONTUSIONS AND WOUNDS OF THE SKULL.

Contusions of the skull.—There seems no doubt that in blows or falls upon the head, the bones of the skull may be injured and their vascular supply interfered with, without any actual fracture of the bones. In former days, however, the effects of contusion were confused with those of septic infection. If after an injury no distinct wound of the scalp were present it was assumed that all the symptoms were due to the simple effects of contusion. Among these symptoms were suppuration superficial to or beneath the skull, with necrosis, more or less complete, of the bones of the skull. There is no doubt, in the light of the present knowledge concerning the causes of suppuration, that most of these cases were due to septic infection; the micro-organisms gaining entrance by some slight, unnoticed abrasion, or by being ground into a bruised scalp. Apart from the septic cases which will be considered elsewhere (*see* page 184), certain changes may take place in the bone following an injury not severe enough to cause a fracture of the bones. In some cases the injured bone may gradually increase in size. The exact nature of this enlargement is obscure; but some persons are satisfied to call it chronic inflammation. In other cases the pericranium may be badly bruised, and, together with the dura mater, may be separated from the bone. This may be followed by necrosis of the whole thickness of the bone, or of a part of the inner or outer table. It was suggested by Percival Pott, and it seems quite probable, that in a violent blow the diploë may to a certain extent be disorganised without a fracture of either table. The elasticity of the two tables is considerably more perfect than that of the diploë. This question will be again discussed when dealing with inflammation of the cranial bones. (*See* page 184.)

Wounds of the skull.—By many authors wounds of the skull are considered in connection with fractures; but with the exception of those caused by blunt instruments they present many points of difference, and it is more convenient to describe them separately. Wounds of the skull may be caused by pointed instruments, by sharp-cutting instruments, by blunt instruments, and by firearms.

Wounds caused by blunt instruments resemble in many respects, and are frequently associated with, fracture of the skull, and they will be considered together with fracture.

Gunshot wounds, owing to their special characters, will be considered separately (page 153).

In this place, therefore, wounds caused by pointed or by sharp-cutting instruments will be dealt with.

1. Wounds of the skull caused by pointed instruments.—These are frequently called punctured fractures of the skull. They are by no means rare, and may be followed by most serious and dangerous results. If the point of the instrument does

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not completely penetrate the bone, or does not lead to a depression of the inner table, no serious result is likely to follow. Sometimes the point of the instrument breaks and remains embedded in the bone. If this be removed at once no bad effects are likely to follow ; but if it be allowed to remain, and should happen to be septic, most serious results may ensue.

Complete perforation of the skull by sharp instruments is a most serious accident, as septic matter is very likely to gain admittance, and may lead to intra-cranial inflammation and suppuration. A not uncommon situation for this form of injury is in the roof of the orbit.



Fig. 351.—Recent Sabre-wound of the Skull. (From a specimen in the Hunterian Museum.

Treatment.—In all cases of wound of the skull by a pointed instrument the wound should be enlarged and the bone carefully examined. If there be any suspicion of perforation the trephine should be applied over the punctured area, and a disc of bone removed. Any depressed portions of the inner table should be removed and the wound cleansed with an antiseptic lotion. If the point of the instrument be embedded in the bone it must be removed. A chisel or gouge to cut away the bone around the foreign body will be found very useful.

If it is found that the dura mater is punctured that membrane should be incised, and the underlying convolutions examined. A very small drainage-tube should be left just outside the dura mater for two or three days in case suppuration should supervene. In the after-treatment of the case the surgeon must carefully watch for any sign of intra-cranial trouble.

2. Wounds caused by sharp-cutting instruments.—

Wounds inflicted by sabres are typical examples of injuries of this kind. A clean cut may be made into bone to a varying depth, or may penetrate the bone and inflict more or less damage upon the brain and its membranes. Sometimes a piece of bone may be chipped away, as in Fig. 551, which represents a recent wound by a sword in the frontal region. In other cases the sword may completely penetrate the bone, and partially separate a portion, as in Fig. 552, which represents a wound inflicted some years previously.

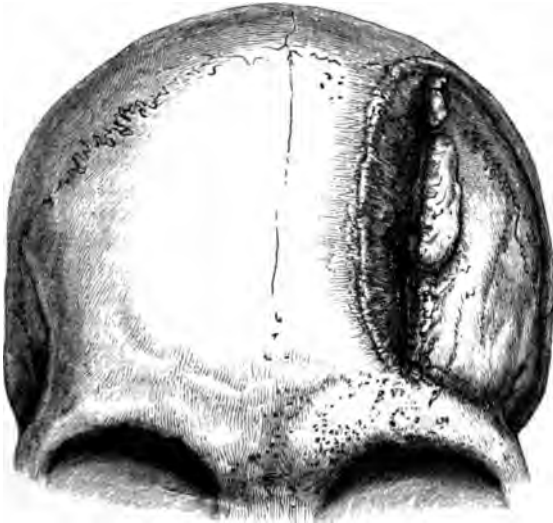


Fig. 552.—Old Sabre-wound of the Skull. (From a specimen in the Hunterian Museum.)

Treatment.—Careful examination of the wound, and removal of any depressed bone by chisel or trephine, should be carried out. Strict antiseptic treatment and free drainage are, of course, essential.

Fractures of the skull. Protective mechanism of the skull.—The chief function of the skull is to protect the brain and its appendages from the ordinary forms of violence to which any animal in the normal course of its life is exposed. This protective mechanism of the skull may be considered from three points of view.

(a) *The greater thickness and strength of certain portions of the skull.*—The skull varies in thickness from 0·5 mm. to 7·5 mm. Those parts most exposed to external injury or muscular action are thicker. Thus, the bones forming the calvaria and the mastoid bone are thick and dense, whereas, on the other hand, the squamous portion of the temporal bone and adjacent portion of parietal bone are thin, being protected by the temporal muscle. The occipital fossæ are thin owing to the protection afforded by the muscles arising

from the curved line of the occipital bone. Again, in the base of the skull the bone is weakened in places by the passage of nerves and vessels through certain foramina.

(b) *The perfection of elasticity possessed by the cranial bones.*—The fact that the elasticity possessed by the skull is fairly perfect within certain limits has been proved experimentally, in various ways, by numerous observers. Bruns, by compressing the skull in a vice, found that one of the diameters could be diminished by one centimetre without any fracture taking place. The diminution in one diameter was accompanied by an equal increase in the other.

Felizet blackened the surface of a skull, and then dropped it from a height on to a marble floor covered with white paper. As the height was increased the black mark made by the skull on the paper became larger, indicating a greater flattening of the skull at the point of impact. On further increasing the height of the fall an oval fissure was produced in the vault of the skull, and the long axis of this fissure was at right angles to the long diameter of the skull.

By filling the skull with paraffin, and allowing the latter to solidify, the fact was proved that the skull is flattened at the point of impact, and even a depression may be found in the paraffin before a fracture occurs. This flattening of the skull has been termed the "cone of depression."

It has been assumed, though by no means definitely proved, that at the point opposite to the flattening there is a bulging, which has been termed the "cone of bulging."

(c) *The mode of transmission of vibrations through the bones of the skull.*—The vibrations that affect the skull in ordinary movements of the body run chiefly in two directions—from above downwards, and from below upwards; the former in blows upon the head, the latter in falls upon the feet. It is evident that the vault, owing to its uniform thickness and density, would be able to vibrate as a whole, and to transmit the vibrations fairly equally to its different parts. On the other hand, the inequality in the thickness and density of the bones forming the sides and base of the skull would not allow this uniform vibration, but is especially constructed to transmit vibrations in certain directions. On examining a skull it will be noticed that there are well-marked buttresses at the junction of the vault with the base, which are arranged in six series. On each side there are two, one formed by the orbito-sphenoid anteriorly, and the other by the petro-mastoid posteriorly. At the anterior end is the fronto-ethmoid, and at the posterior end is the occipital. (See Fig. 553.) These buttresses meet in the sella turcica, which has been termed the "centre of resistance," and in any violence to the vault the vibrations are conducted by these buttresses to the sella turcica. The base of the brain is separated from this structure by a dilated portion of the subarachnoid space, containing cerebro-spinal fluid, which, acting as a water cushion, prevents the vibrations from affecting the brain to any considerable extent. Again, in falls upon the feet, the vibrations caused by the vertebral column impinging

against the skull pass from the region of the foramen magnum anteriorly *via* the sella turcica to the vault, and posteriorly *via* the occipital crest and protuberance.

Ætiology of fractures of the skull.—Broadly speaking, fractures of the skull may be produced by forces acting in two ways. First, where the force is applied over a small area, and only local effects are produced; in other words, the fracture is limited to the area of the concentrated blow.

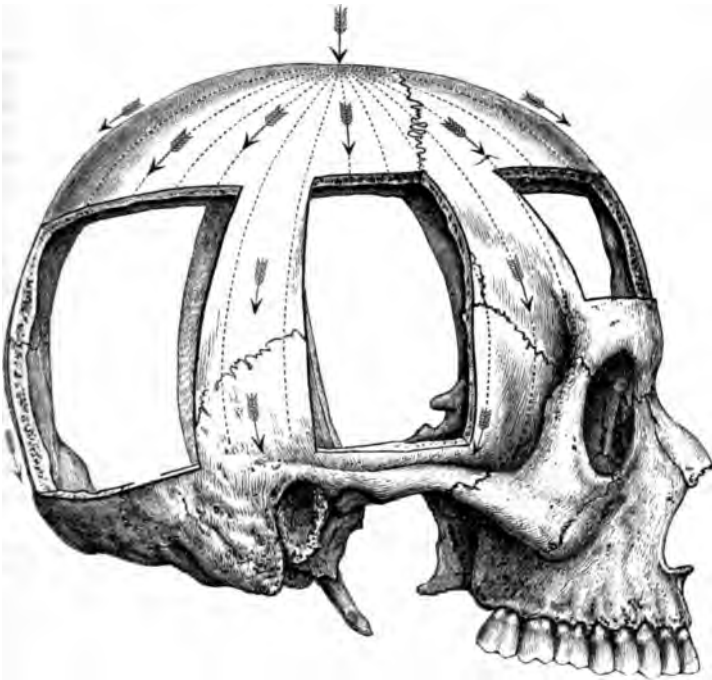


Fig. 553.—Showing the Paths of Conduction of Vibrations in Blows upon the Head. (From a preparation made by the author.)

Secondly, where the blow is diffused, and the fracture may take place at a spot remote from the point of application of the force, or the fracture may extend to a considerable distance from the point struck.

Another way of expressing this difference is to say that there are "direct" and "indirect" fractures.

(a) *Fractures caused by a concentrated blow. Direct fractures.*—The majority of cases of fractures limited to the vault of the skull are produced by direct violence; the force, acting upon a small area of the vault, produces a circumscribed lesion. Blows with sharp-pointed or cutting instruments, gunshot wounds, and falls on angular objects, may produce typical examples of direct fractures.

In the base of the skull, falls on the feet, causing fractures around the foramen magnum, or falls on the lower jaw, causing fractures in the region of the glenoid cavity, are examples of direct fractures. The punctured wounds of the base of the skull already described may be looked upon as direct fractures.

(b) *Fractures caused by a diffused blow. Indirect fractures.*—When the force is diffused, as in falls upon the head, the skull as a whole is affected by the force, and, as a rule, both the vault and the base suffer in consequence.

The exact mechanism by which the fractures by irradiation, as they are sometimes called, are produced, has been much discussed. For many years it was universally taught that fractures of the base of the skull following diffused blows were caused by the vibrations meeting at a point opposite to that struck. This was the theory of fractures by *contre-coup*. This was founded upon theoretical considerations, and no absolute proof of its occurrence has yet been given.

It is probably true that a fracture of the skull may take place at some distance from the point struck, but there is no evidence to show that in these cases the vibrations are conducted to the opposite point of the skull, and, meeting there, cause a fracture.

In 1844 Aran published the results of an experimental and clinical investigation on this subject, and came to the conclusion, which is generally known as Aran's law, that fractures of the base occur by the radiation of fissured fractures from the point struck, and that these fissures take the nearest way from the point struck to the base. Thus, if a man fell from a height on to the vault of the skull, a fracture would be produced at the point of impact, and from it a fissure would start and take the shortest path to the base.

In no instance did Aran find a fracture of the base without being able to trace the fracture round to the vault. There is no doubt, however, that sometimes a fracture of the base may take place without any fracture of the vault, and this would not be the case if Aran's law were of universal application. In order to explain such cases as these, several German surgeons have adopted another theory. If a hollow sphere be compressed a fracture will occur, either at the points compressed or at that part of the sphere which is most distended—i.e. at the equatorial line equidistant from the two points of compression. Further, the direction of the fracture will be parallel with the line of force producing the compression. In a sphere of uniform thickness this fracture might commence at any point on the equator, and travel towards either pole. Now the skull is not of uniform thickness, especially in the region of the base (see page 139 and Fig. 553), therefore there will be a tendency for the fracture to occur in the weaker segments. This is known as the *compression* or *bursting* theory, and is thought by some to explain the mode of occurrence of all indirect fractures of the skull.

Fractures of the vault of the skull.—These may be complete or incomplete.

Incomplete.—Fractures of the external table alone are occasionally met with. They occur usually in places where the diploë is very thick, as in the region of the forehead. They are sometimes met with, however, in other parts of the vault. Fractures of the internal table alone are occasionally met with as a result of gunshot wounds.

Complete.—A variety of fractures may be met with as the result of gunshot wounds, and these will be described later. (See page 153.) Apart from these, fractures of the vault may be classified as fissured, punctured, depressed, star-shaped, and comminuted. Punctured fractures have already been considered among the wounds of the skull. Sometimes, however, in addition to the puncture there is a more or less extensive fracture.



Fig. 554.—Gutter Fracture of the Skull. (Hutchinson.)

Fissured fractures.—These are very frequently associated with fractures of the base. They are often of considerable length, and may radiate in different directions. When uncomplicated by any wound of the scalp, it may be impossible to diagnose them, unless some symptoms of cerebral compression lead one to suspect a fracture. If the scalp is wounded, but the periosteum is intact, the

fracture may be readily overlooked. Even when the periosteum is also wounded the diagnosis is not always easy, as certain fallacies may exist.

In recent fissured fractures a bright red streak indicates the line of separation, but after a few days this may change to a dark or al-

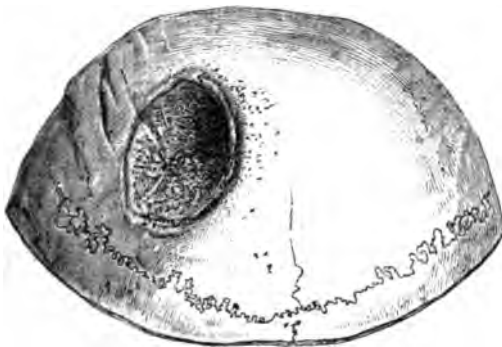


Fig. 555.—Depressed Fracture of the Vault (outer surface). (From a specimen in the Hunterian Museum.)

most black line. The presence of this red or black line is an important guide in distinguishing between a suture and a fissured fracture. The characteristic irregularity of the line of a suture and its anatomical situation would also aid us.

Incised wounds of the periosteum, when felt with a probe, may simulate fissured fracture. By feeling with the finger, the fact that the irregularity is due to a ridge of soft tissue can be readily established.

Depressed fractures.—In complete fractures, when the force

acts from without, the inner table is fractured to a greater extent than the outer, and is more comminuted. Various explanations of this have been offered. The greater brittleness of the inner table, the distribution of the force as it passes through the diploë, the greater curve of the inner table, etc., are among the many theories. That



Fig. 556.—Inner Surface of Specimen shown in Fig. 554.

the first and last theories are not sufficient to explain the occurrence is seen where the violence is from within and where the outer table is affected much more than the inner.

Teevan's explanation is probably correct, namely, that the table that is exposed to most ex-

tension gives way first. This is analogous to the way in which a stick breaks when bent across the knee.

It is sometimes stated that in children there may be a depression of the bones of the skull without any fracture. In all cases, however, where a post-mortem examination has been made, a rupture of the inner or of both the tables has been found; in some cases the solution of continuity being of an incomplete form—the well-known greenstick fracture.

In the diagnosis of depressed fracture, it must be remembered that a contusion of the soft parts alone may present signs very similar to depressed fracture. The peculiar crateriform swelling of a cephalhæmatoma (*see* page 134) may give the idea of a depressed fracture.

By prolonged and forcible pressure on the edge, the raised margin can be made to disappear in the case of cephalhæmatoma. Depressed fractures may take various forms. In some

cases there is an indentation from one to three or four inches in length, not unlike a gutter, hence the term *gutter fracture* (Fig. 554). In other cases the depression is more or less circular, and to this the term *pond fracture* is sometimes applied (Figs. 555, 556, and 557). Sometimes the piece of bone struck breaks up into several portions, some of which may be more depressed than others; they are the *comminuted fractures*. Occasionally the lines of fracture start from



Fig. 557.—Pond Fracture of Skull (Hutchinson.)

a central point, which is the seat of maximum depression, and radiate from that point so as to suggest the term *star-shaped fracture*.

Symptoms and diagnosis of fracture of the vault.—

Cases of fracture of the vault, whether simple or compound, are often complicated by injury to or a septic infection of the intra-cranial contents. Thus the symptoms of concussion or compression of the brain, of meningitis, etc., may be present. Besides these general symptoms, there are certain local ones.

In the case of a compound fracture there is a wound of the scalp, at the bottom of which the fracture can usually be found and its nature and extent determined.

The symptoms of a simple fracture of the vault are not so evident, vary considerably, and occasionally may be quite absent. They are :—

(1) *Depression of the bone.*—

Where this is present there is no difficulty in recognising the fracture. When there is no depression it may be quite impossible to diagnose a fracture, e.g. a fissured fracture. Care must be taken not to mistake the central

part of a cephalhæmatoma (see page 134) for a depressed fracture. Again, certain congenital malformations or results of former injuries may lead to confusion.

(2) *Swelling of the scalp.*—This may be due simply to injury of the soft parts; but if it is considerable in size and very tender on pressure, a fracture should be suspected. An effusion of blood under the epicranial aponeurosis suggests a fracture with wound of one of the blood sinuses. Occasionally in children the swelling may be due to a collection of cerebro-spinal fluid, and this indicates a fracture. (See Traumatic Cephalhydrocele, page 158.)

(3) *Localised tenderness.*—This is often present in cases of fracture, especially if deep pressure be exerted. If the patient be partly insensible, the pain may be sufficient to rouse him.

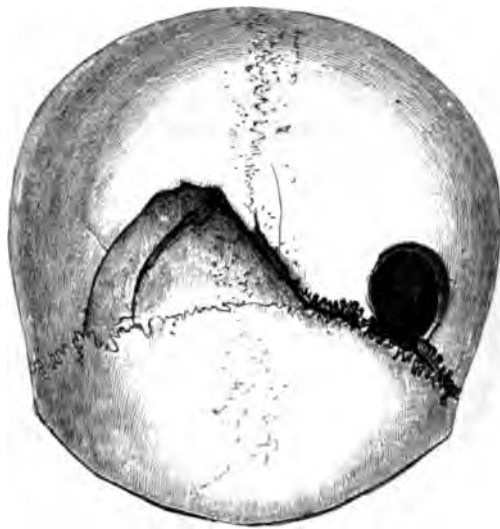


Fig. 558.—Depressed Fracture of the Vault with Separation of the coronal Suture. The circular hole shows where the patient was trephined during life. (From a specimen in the Hunterian Museum.)

Treatment of fracture of the vault.—This will vary according to the nature of the fracture.

If fracture be suspected. The head should be shaved and the patient kept in bed in a darkened room. If there is any headache an ice-bag should be applied to the head. The diet should be light and a purgative administered.

Simple depressed fracture. If there are no symptoms of compression of the brain, it is usually recommended to adopt the treatment just described for suspected fracture. In the case of children, elevation of the depressed bone by an air-pump has been

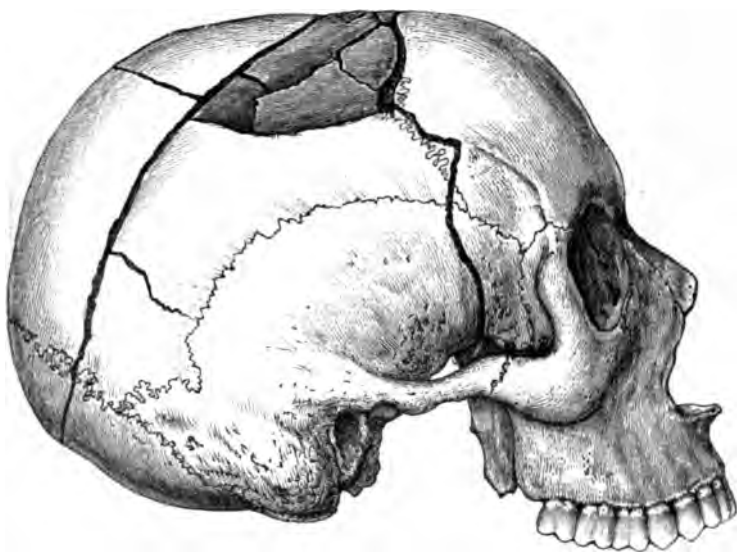


Fig. 559.—Depressed Fracture of the Vault with Fissures radiating to the Base. (Hutchinson.) Compare this with Fig. 553, and notice how the line of fracture avoids the strong buttresses.

tried with success. It is quite open to discussion, however, whether it is not advisable to trephine in these cases. Although no symptoms may be present immediately after the injury, yet in many cases the inner table is splintered, and, later, may cause traumatic epilepsy. The operation of trephining in such cases is quite free from risk, the dura mater is not opened, and whenever the depression is at all marked, the writer considers that trephining and elevation of the depressed bone is the proper treatment.

If symptoms of compression of the brain or of irritation of the cerebral cortex are present, trephining should certainly be performed, and all depressed fragments elevated. If performed aseptically, the operation is quite devoid of risk.

In all *compound fractures*, whether there be symptoms of compression or not, the wound should be enlarged if necessary and

the skull examined. Either by the trephine or chisel the depressed fragments should be elevated or removed. Strict antiseptic precautions should be taken, and any dirt or foreign bodies removed. In many cases, by means of a chisel and gouge forceps, the depressed fragments can be removed with greater facility than by trephining.

Symptoms and diagnosis of fracture of the base of the skull.—In nearly all cases there is no external wound, although, in a sense, many of them are compound fractures. For example, a fracture through the middle fossa, with rupture of the tympanic membrane and a fracture of the anterior fossa with fracture of the cribriform plate and the membrane covering it, are really compound, although it may be difficult or impossible to discover the external wound.

Any injury sufficiently great to cause fracture of the base will cause injury to the intra-cranial contents, especially concussion of the brain. Compression of the brain from extravasation of blood is a frequent complication, and, later, septic infection of the meninges may set in.

Fractures of the base of the skull differ very much in the direction taken by the fracture. Broadly speaking, they may be divided into transverse and longitudinal. It has already been mentioned (page 142) that the fracture is nearly always parallel to the direction of the forces producing it, therefore in falls or blows upon the side of the head the fracture of the base will be transverse, and according to the point of application of the force, it will be in that one of the three fossæ of the skull nearest the point struck. A transverse fracture seldom passes from one fossa to the next. In Fig. 560 are seen three examples of transverse fracture of the base of the skull, and in each case the fracture is limited to one fossa.

In blows upon the frontal or occipital region a longitudinal fracture is produced, and this often involves the three fossæ. (See Fig. 560, D.)

The special symptoms of fracture of the base of the skull may be classified in the following way:—

(1) *Escape of brain matter.*—Occasionally, in very severe fractures, portions of brain matter may escape through the fractured bone. In a fracture of the anterior fossa it may appear either in the nose or in the mouth. In fracture of the middle fossa it appears in the auditory meatus, and in that of the posterior fossa in the back of the pharynx. Such a symptom is absolutely diagnostic of fracture of the base of the skull.

(2) *Escape of blood.*—The escape of blood from the nose, ear, or mouth, is a very common occurrence after injuries of the head, and may exist when there is no fracture of the base of the skull. Thus hæmorrhage from the nose, "traumatic epistaxis," may be caused by a fracture of the anterior fossa of the skull, but may often be due to an injury to the mucous membrane of the nose without any fracture.

Hæmorrhage from the external auditory meatus, "otorrhagia" it

is sometimes called, is an almost constant sign of fracture of the middle fossa. It is most important to remember, however, that otorrhagia may very often exist without any fracture of the middle fossa. According to the writer's experience, in the majority of cases of hæmorrhage from the ear there is no evidence that the base of the skull is fractured.

Injury to the auditory meatus, for instance, that caused by a fall upon the chin forcing the condyle of the jaw against the bony meatus, may lead to hæmorrhage from the meatus.

Blood may also trickle from a wound of the pinna or adjacent part of the scalp into the meatus and mislead one.

In either of these cases the source of the hæmorrhage can be easily determined by mopping or syringing out the ear and looking through an ear speculum.

The greatest difficulty in diagnosis is met with in cases of rupture of the tympanic membrane itself. This membrane may be ruptured by an injury to the head without any fracture of the middle fossa. The only two points to guide one are: First, that, as a rule, the otorrhagia is more continuous and profuse where the base is fractured; and, secondly, that hearing on the side of the injury is immediately and completely lost when the base is fractured.

Owing to the great importance of recognising the source of the blood in otorrhagia following injury it will be of use to recapitulate the causes:—

- (a) Trickling of blood into the meatus from a wound of the adjacent region.
- (b) Injury to osseous or cartilaginous meatus, or to both.
- (c) Injury to tympanic membrane by foreign bodies introduced through the external meatus.
- (d) Rupture of tympanic membrane without any osseous lesion.
- (e) Rupture of tympanic membrane with fracture of mastoid process.
- (f) Rupture of tympanic membrane with fracture of petrous portion of temporal bone (the ordinary fracture through the middle fossa).

Hæmorrhage into the mouth caused by fracture of the posterior fossa of the skull, basi-occipital and basi-sphenoid is sometimes met with. Both in these cases and in hæmorrhage from the nose the blood may be swallowed, and vomited up later.

3. *Escape of cerebro-spinal fluid.*—This may be said to be almost absolutely diagnostic of a fracture of the base of the skull. It may escape from the nose, from the external auditory meatus, or from the Eustachian tube, according to the seat and nature of the fracture. It can only be mistaken for liquor Cotunnii and serous exudation from an otitis media.

From the former it can be distinguished by the fact that in fractures of the base the cerebro-spinal fluid generally escapes in considerable amount and continues to do so for some hours or days. In injury to the labyrinth the escape of the liquor Cotunnii is very



A
Transverse Fracture of the anterior Fossa.
(From a specimen in the London Hospital
Museum.)



B
Transverse Fracture of the middle Fossa.
(From a specimen in the London Hospital
Museum.)



C
Transverse Fracture of the posterior Fossa.
(From a patient who died in the London
Hospital.)



D
Longitudinal Fracture of the Skull involving
all the Fossae. (From a patient who died
in the London Hospital.)

Fig. 560.

small. From serous otitis media it can be distinguished by the fact that the serous exudation will contain a considerable quantity of albumen. Cerebro-spinal fluid only contains a trace of albumen which cannot be recognised by ordinary clinical tests for albumen. In addition it contains an appreciable quantity of sodium chloride, and a substance which has a reducing action upon cupric oxide. When the middle fossa is fractured and the tympanic membrane is uninjured, the fluid may escape along the Eustachian tube into the mouth. The presence and source of the fluid might easily be missed in these cases.

4. *Presence of bruises or ecchymoses.*—On the whole, the diagnostic value of ecchymosis is but slight. In many cases it is very difficult to say whether the bruise has been caused by a direct blow on the soft tissues, or whether it is due to a fracture of the skull.

Most ecchymoses in the occipital region are due to direct injury. In the mastoid region they are more commonly caused by a fracture of the base of the skull.

In the region of the eyeball ecchymoses are common, and may be caused by direct injury, the ordinary "black eye," or may be caused by the oozing of the blood through a fracture of the orbital plate. When caused by a fracture of the base of the skull the ecchymosis has the following character:—

It appears some considerable time after the injury (two to three days).

The ecchymosis spreads gradually from the seat of fracture towards the surface; thus the eyeball is first of all slightly pushed forwards owing to effusion into the cellular tissue of the orbit. The blood then appears beneath the conjunctiva, usually at the outer side, forming a clot triangular in shape with the apex of the triangle forwards. The lower lid may then become affected; as a rule, the upper lid is not affected, but if in addition to an injury of the orbital plates the orbital ridge is fractured, blood readily finds its way into the upper lid, and so the distinction from an ecchymosis due to direct injury may be impossible.

In an ordinary "black eye," due to a blow in that region, the ecchymosis appears much sooner and more rapidly spreads to the conjunctiva. If the conjunctiva is struck at the same time the bruise appears on it almost immediately. In these cases the hæmorrhage into the conjunctiva is more superficial; it is intra-conjunctival rather than sub-conjunctival, and as a consequence it is more readily oxidised and the bruise is of a brighter red colour. By gliding the conjunctiva upon the subjacent eyeball the bruise is seen to move with the conjunctiva in cases due to a direct blow.

5. *Injuries to cranial nerves.*—Some difference of opinion exists among observers concerning the relative frequency of these injuries. In my experience injuries of the facial nerve are most frequent, followed in order by the auditory, the olfactory, optic, and the oculo-motor nerves. Of the last-named the sixth was most often and the fourth least often affected. Injury to the glosso-pharyngeal

vagus, spinal accessory, and hypoglossal is very rare, and when existing, the injury is so severe that the patients seldom survive long.

The olfactory nerve.—This may be injured by direct punctured fractures of the ethmoidal plates. It may also be involved in ordinary fractures of the anterior fossa. Sometimes anosmia follows blows upon the head without any evidence that fracture has taken place. In these cases the olfactory nerve may be injured by *contre-coup*.

The optic nerve.—This nerve is usually injured as it passes through the optic foramen, and is often associated with injury to the oculomotor nerves. According to the extent of the injury greater or less loss of vision results. Evidence of extravasation of blood into the nerve may be obtained by looking at the optic disc.

The third nerve may be completely or partially paralysed, the latter being much more frequent. Ptosis and mydriasis are the commonest symptoms. In cases of injury to this nerve the fracture of the orbital plate is probably nearly always the cause.

The fourth nerve is very rarely injured. Diplopia, especially on descending a flight of stairs, may be the only symptom.

The fifth nerve is occasionally involved in fractures of the base, the third division being most often affected. There would be evidence of motor or sensory paralysis, according to the part of the nerve injured.

The sixth nerve is the most often affected of the ocular nerves. This is explained by the fact that as it passes forwards to the orbit it is in intimate contact with the apex of the petrous bone, and fractures of the bone in this region are more common than in any other.

The seventh or facial nerve may be affected in two ways—

Primarily, by being torn across or bruised at the time when the fracture occurs ;

Secondarily, usually from two to eight days after the injury. This late paralysis may be due to involvement of the nerve in the process of repair of the bone, or to the formation of clots of blood upon the nerve. In some cases the nerve becomes involved by inflammation spreading from an otitis media which often follows a fracture of the bone.

In all these secondary cases the paralysis generally begins to disappear by the third or fourth week.

The eighth or auditory nerve.—In fractures of the middle fossa the labyrinth together with the termination of the auditory nerve is frequently involved in the fracture, and more or less deafness of a permanent nature ensues.

Injury of the remaining cranial nerves is very rare in fractures of the base of the skull.

Nystagmus is occasionally present, but its pathology is most obscure.

6. *Surgical emphysema*.—In rare instances of fracture of the base of the skull where the frontal sinuses or mastoid cells are

involved, there may be some surgical emphysema owing to the escape of air through the ruptured walls of the sinuses into the areolar tissue of the scalp.

DIFFERENTIAL DIAGNOSIS OF FRACTURES OF THE BASE OF THE SKULL.

	<i>Anterior Fossa.</i>	<i>Middle Fossa.</i>	<i>Posterior Fossa.</i>
1. Point of application of violence.	In frontal region.	<i>a.</i> In transverse fractures in temporal or parietal region. <i>b.</i> In longitudinal fractures in occipital region.	In occipital region, or by falling on feet.
2. Hæmorrhage.	From the nose.	From the external auditory meatus.	From the mouth.
3. Escape of brain matter.	Into the nasal fossæ.	From the external auditory meatus.	Into the back of the pharynx.
4. Escape of cerebro-spinal fluid.	From the nose.	From the external auditory meatus.	Very rarely into back of pharynx.
5. Ecchymoses.	Into cellular tissue of orbit (exophthalmos) and subconjunctival.	In mastoid region.	In mastoid or occipital region, or posterior wall of pharynx.
6. Injury to nerves.	<i>a.</i> Olfactory, anosmia. <i>b.</i> Optic, blindness. <i>c.</i> 3rd nerve—ptosis, mydriasis, etc.	<i>a.</i> 6th nerve—external squint. <i>b.</i> 7th nerve—facial paralysis and paralysis of chorda tympani. <i>c.</i> 8th nerve—deafness.	Cranial nerves very rarely affected.

Treatment of fractures of the base of the skull.—

The great danger in fracture of the base is the occurrence of septic inflammation of the meninges or brain. Many cases of fracture of the base are compound fractures, opening into the nostril, ear, or pharynx.

It is most important to take every precaution to prevent sepsis. In fractures of the anterior fossa the nasal fossæ should be sprayed with an antiseptic lotion and iodoform powder blown up as far as possible.

In fractures of the middle fossa the ear should be syringed out with boracic or carbolic lotion, and the meatus plugged with antiseptic cotton-wool.

In fracture of the posterior fossa, if compound into the mouth, every effort should be made by sprays, iodoform powder, etc., to keep the wound in the wall of the pharynx as free from decomposition as possible.

Any complication such as concussion or compression of the brain or septic inflammation must be treated in the way already directed when treating of these affections.

Gunshot injuries of the head. 1. **Gunshot wounds of the scalp.**—According to Gross, of the total number of gunshot wounds of the head in the American Civil War, rather less than three-quarters were limited to the scalp, and the remainder involved either the skull alone or both the skull and the brain. Gunshot wounds of the scalp, without any injury to the skull or brain, run a very favourable course. The mortality in the American war was 2·1 per cent., and in the Franco-Prussian only 0·54 per cent.

The scalp may be simply grazed or grooved by the bullet, or the latter may perforate the scalp, leaving an aperture of entry and one of exit. In the days of the round bullet the projectile might run for some distance between the scalp and the bone, following the curve of the latter. With the elongated bullets of the present day such wounds are never met with.

The chief dangers of gunshot wounds of the scalp are gangrene, extensive suppuration, erysipelas, and pyæmia.

Sometimes portions of the scalp may become gangrenous owing to the violence of the injury. As a rule, however, the gangrene is the result of septic inflammation.

The treatment is similar to that already described for wounds of the scalp; bullets, *débris* of hair, etc., must, of course, be removed.

2. **Gunshot wounds of the skull.**—It has been stated that contusions of the skull-bones may occur without any wound of the scalp. This may have been true in the case of round projectiles of low velocity, but in modern warfare they are very unlikely to occur.

Fractures of the skull by projectiles may be complete or incomplete.

Incomplete fractures.—These may involve either the inner table or the outer table. Fracture of the inner table alone can only be explained satisfactorily by Teevan's theory. In the case of the outer table the diagnosis is usually easily made by examining the wound; but in the case of the inner table the difficulty may be very great. A difference in the percussion note at a particular spot is suspicious, and in some cases a slight rub may be heard as the cardiac and respiratory pulsations of the brain cause the dura mater to rub against the depressed fragments. The only trustworthy symptom is the presence of some localised compression or laceration of the brain showing itself within a few days of the accident.

Complete fractures.—In these cases the projectile may or may not perforate the cranial wall.

Fractures without penetration.—There is generally more or less depression of the fragments, the inner table being more extensively fractured than the outer one, according to Teevan's law. These fractures resemble in most respects ordinary depressed fractures, and are caused by projectiles striking the skull in a tangential direction.

Fractures with penetration.—In these cases the projectile may strike the skull perpendicularly or tangentially, and may remain

embedded in the brain or skull, or may completely penetrate these structures.

In the case of the small modern bullets, possessing a resisting envelope, and travelling at an enormous velocity, penetration is the rule. When considering the effect of gunshot wounds we have to bear in mind that the nature of the substance traversed by the bullet plays a very important part in the amount of destruction that is produced. This was shown some years ago by Huguier. He compared the effects produced by sending a bullet through a skull filled with dry solid material, and one filled with water or wet material. The destructive effect in the latter case is infinitely greater, and, we may say, that up to a certain point the destructive effect produced by the passage of a bullet through any substance varies directly as its viscosity. The most probable explanation of this fact is that the projectile, in its passage through the viscous substance, communicates its velocity to the particles of water, and so an explosive force is produced. The explosive force produced by the passage of a bullet through the brain may cause most extensive fractures of the skull. This force is, in some cases, sufficient to cause considerable momentary gaping of the fracture.

This is shown by cases where a bullet passes through the skull and no aperture of exit in the cranial wall can be found, the bullet having escaped through the momentary gaping of the fissured fracture. In addition to this displacement of the brain *en masse*, in accordance with the rule of hydrodynamics, the cerebro-spinal fluid in the ventricles of the brain is exposed to a sudden movement, and tends to press injuriously upon the walls of the ventricles. Owing to the important centres situated around the fourth ventricle, any sudden distension of this ventricle may lead to very serious results. Horsley has shown that when a bullet is sent through the skull and brain of a living dog the respiration immediately stops, although the heart continues to beat with but little alteration.

By performing artificial respiration for a few minutes the action of the respiratory centre is restored, and natural breathing can be re-established.

When a bullet passes through a solid substance the aperture of exit is always larger than the aperture of entry (Figs. 561, 562). Several explanations of this have been offered.

The most probable one is that the projectile communicates its velocity to the particles through which it passes and carries these particles with it. In the case of perforating wounds there are three conditions to consider.

1. The velocity of the projectile. Experiments conducted by some French surgeons show that if the velocity does not exceed 200 metres per second the orifice of entry is regular and without fissure. With a greater velocity fissured fractures are produced radiating from the apertures of entry and exit. If the velocity be higher than 300 metres per second most extensive fractures are produced, not necessarily having any connection with the apertures of entry or

exit. These indirect fractures are probably caused by the explosive force developed by the bullet in passing through a viscous substance as described above.

2. The angle of incidence of the projectile. Generally speaking, the smaller the angle of incidence, i.e. the more tangential the projectile, the greater the damage to the skull.

3. The direction of the projectile. This has an influence upon the kind of fracture produced. Thus, when a bullet strikes the head in the frontal region, passes through and leaves it in the occipital region, the fracture is longitudinal in direction (Fig. 563). Again, when the bullet passes through the skull from side to side the fracture is transverse in direction. Fractures of the base

of the skull may be direct or indirect.

The direct fractures are generally produced by gunshot wounds of the orbit, of the region of the ear, or through the mouth. The indirect fractures are those radiating from the vault, and are produced by the explosive force already discussed (p. 235, Vol. I.).

Treatment of gunshot wounds of the skull.

Thorough disinfection of the wound must be carried out, and any complications that may arise must be attended to. The question concerning extraction of the projectile has been much discussed. It may probably be summed up in this way. If the bullet be accessible, it should be removed unless great damage

to important parts of the brain would necessarily follow. If the locality of the bullet cannot be ascertained, or if it is found to be too deeply situated to be removed with safety, it may be left. If,

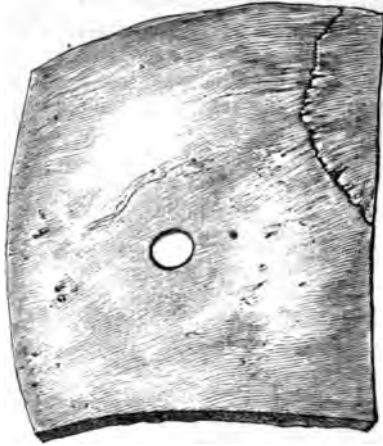


Fig. 561.—Revolver Wound of Skull. Aperture of entry. (From a specimen in the Hunterian Museum.)

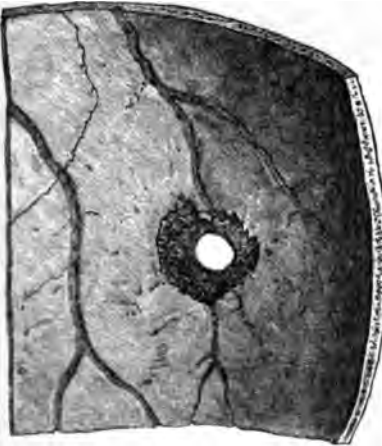


Fig. 562.—Inner Surface of Specimen shown in Fig. 561.

later, symptoms arise, and any idea concerning its position can be obtained, it should be removed. The use of electrical apparatus for detecting its presence, and of special instruments for the extraction of bullets, cannot be described here.

Injuries of the head in children. Birth injuries.—Certain injuries of the head in new-born children received during the act of parturition, such as fractures and depressions of the skull, owing to pressure against the sacral promontory, or to the application

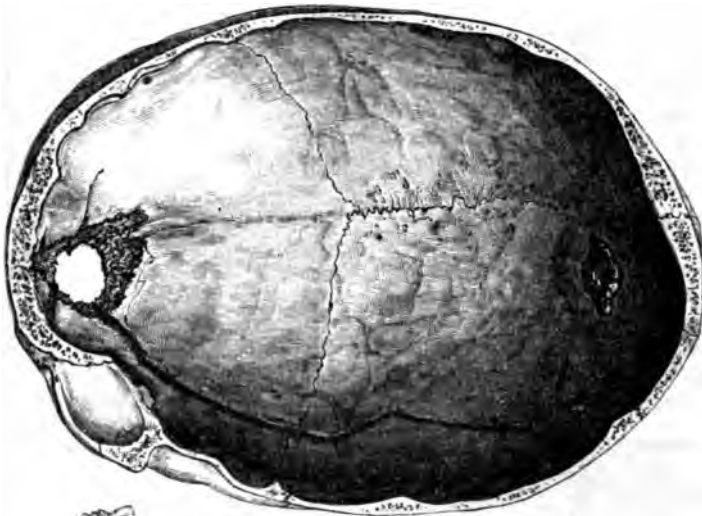


Fig. 563.—Gunshot Wound of Skull, with a longitudinal Fracture produced by "explosive force." The bullet is seen lying in the occipital region. (From a specimen in the Hunterian Museum.)

of forceps, or to falls of the fœtus on to the floor, belong to the obstetrician rather than to the surgeon.

Owing to the occasional difficulty in diagnosis, the cephal-hæmatoma is an exception to this statement, and is frequently brought to the surgeon for treatment. It has already been fully described. (See page 134.)

Peculiarities of head injuries in children.—Owing to the non-union of the sutures and the marked resiliency of the cranial bones, injuries to the head during the early years of life present certain peculiarities. Thus the head may be exposed to very considerable violence without a fracture of the bones, and with no appreciable injury to the brain. Again, deep depressions may be produced by a blow at one part of the skull without any cerebral symptoms resulting, owing to a compensatory bulging of the skull at some other point (Fig. 564). Sometimes, however, very grave injury may be inflicted upon the brain

without any evidence of injury to the skull. Owing to its elasticity, the skull may return to its normal shape, after even severe crushing. In very rare instances the brain matter has escaped through a fracture in the skull, and formed a tumour beneath the scalp, a *traumatic encephalocele*. Such a tumour will pulsate synchronously with the arteries, and an impulse will be felt during expiratory efforts. Children recover from very severe fractures of the base of the skull. The intra-cranial complications, such as concussion and compression of the brain, are much less fatal in children than in adults. Very extensive compound depressed fractures of the vault, with or without rupture of the dura mater, do well in children, provided septic lepto-meningitis is avoided.

In the treatment of head injuries in children, the general principles are similar to those employed in adults.

There is one important question to discuss, however, and that is whether, in cases of marked depression of the cranial bones, without signs of cerebral injury, attempt should be made to elevate the depressed bone. In many cases the depression gradually disappears without any interference, owing to the pressure exerted by the growth of the brain. In cases where a marked depression persists, there is always a danger that some local change may take place in the brain.

For instance, in some cases where the depression is over the sensori-motor area, traumatic epilepsy has developed. It is in order to avoid such a serious result that some surgeons recommend elevation of the bone by means of trephining or chiselling. The operation is almost devoid of danger, and seems to be the proper line of treatment.

Separation of sutures.—This is a rare accident in children, but is of considerable practical importance, because it may lead to a very serious condition. At the time of the infliction of the injury there is generally some concussion of the brain, from which the child usually recovers. One of two results may then follow. The separation may increase, and through the enlarged gap a part of the brain and some cerebro-spinal fluid may protrude, forming what is known as a traumatic *encephalocele*. In some cases cerebro-spinal fluid alone may be present in the protrusion, and this is termed a false meningocele or *traumatic cephalohydrocele*, which will be



Fig. 564.—Depressed Fracture in a Baby, causing no symptoms. In the course of a few days the depression disappeared.

described fully in the next paragraph. The other result is that the gap may gradually diminish in size by the formation of new bone at its margins.

Traumatic, cephalhydrocele, meningocele falsa.—After a fracture of the vault of the skull in children, a fluctuating tumour may sometimes appear under the scalp, which, on aspiration, is found to contain cerebro-spinal fluid. This tumour may appear immediately after the accident, but usually some days, or even months may elapse before it is noticed. It is generally found in children under two years of age, but the author has met with it as late as the thirteenth year. Not only is the cranial vault fractured, but the dura mater, arachnoid, pia mater, and brain are also lacerated, so that, as a rule, the fluid in the swelling communicates directly with the lateral ventricles. Subsequently to the appearance of this tumour there may be considerable absorption of the bone, leading to the formation of a large gap. The swelling appears most frequently in the parietal region, occasionally over the frontal and occipital bones. As the brain grows, the tumour may increase in size, especially if there be any rickety softening of the cranial bones. The tumour fluctuates and pulsates synchronously with the arteries. During expiration, especially when forcible, it increases in volume. Usually the fluid can be returned into the skull by pressure, and, with the exception of some pain, the reduction is not followed by any serious symptom.

Treatment.—By employing elastic pressure and keeping the child quiet a cure may be effected. If the tension becomes very great, aspiration of the fluid in the tumour, with strict antiseptic precautions, becomes necessary. Even frequently-repeated aspirations, however, fail, as a rule, to lead to a cure. On no account should iodine or other irritating fluids be injected, as death has occurred more than once after this treatment.

If the condition is not cured by compression and aspiration, and the tumour progresses in size, it might be worth while to cut down upon the tumour, and endeavour to close the gap by placing over it a piece of bone and pericranium detached from the adjacent bone by a chisel. It is useless to use the pericranium alone, as it possesses little if any osteogenetic power.

Certain sequelæ of injuries of the head. (1) **Traumatic epilepsy.**—There is no doubt that a form of Jacksonian epilepsy may follow an injury to the head, and that the fits are due to some change in the skull, meninges, or brain, which excites that part of the cerebral cortex in the neighbourhood of the injury.

This subject will be treated in full when dealing with the surgical treatment of epilepsy. (*See* page 216.)

(2) **Derangement of the intellectual faculties.**—These are so numerous that only a short account of them can be given. The most important are :—

(a) *Loss of memory.*—This traumatic amnesia, as it is called, is often met with. The loss of memory may only concern events

connected with the accident, or may affect the memory for events that occurred some days previous to the accident.

(b) *Traumatic somnambulism*.—The patient performs certain actions in what may be called a state of unconsciousness. At any rate, on emerging from this condition the patient has no memory of what has passed.

(c) *Traumatic insanity*.—There is no doubt that insanity may be the result of an accident. It is very doubtful, however, whether the character of the insanity has any special features. In all probability it has not.

(3) **Sensory and motor paralysis of various kinds.**—These vary in each case, and depend upon the exact seat and the extent of the injury to the brain substance.

(4) **Neuralgia and headache.**—It is not uncommon after injuries of the head for the patients to complain of neuralgia and headache, which may be of two kinds. First, a radiating pain affecting chiefly the branches of the trigeminal nerve, as in ordinary forms of neuralgia; secondly, a pain localised to one spot, either continuous with occasional exacerbation or intermittent. The causes of this traumatic cephalalgia, as it has been termed, are probably manifold. Neuromata of the scalp and neuritis of nerves of the scalp are occasional causes. Horsley insists upon the frequency with which thickening of the skull bones may cause this condition. In some cases the pain is produced by alterations in the bone affecting the nerves of the dura mater. If, after trying ordinary medical treatment, no improvement takes place, and having excluded the condition known as *traumatic hysteria*, recourse may be had to operative interference. Trephining should be performed at the tender spot. On removal of the disc of bone, some pathological condition may be rendered evident.

(5) **Affections of organs of special sense.**

(a) *Vision*.—The visual apparatus in the cerebrum, in the optic tract, in the chiasma, or in the optic nerve may be injured. Special works must be consulted for these affections.

(b) *Hearing*.—In cases of fracture of the petrous bone, the auditory nerve may be seriously injured, so as to lead to permanent deafness on the affected side. In other cases in which the labyrinth alone is injured the deafness is incomplete, existing for certain sounds only.

Buzzing and singing in the ears may persist for a long time after an injury. It may be caused by intense congestion of the lining membrane of the tympanum. In some cases where there may be no apparent cause for the noises, it is very probable that there is some lesion in the brain or labyrinth.

When in addition to these noises there is vertigo, injury to the labyrinth is highly probable. As a rule, these subjective symptoms are accompanied by more or less deafness. The cause of the deafness varies in different cases, and is not always obvious. Sometimes a purulent otitis media leading to a great diminution in hearing will follow a fracture of the petrous bone.

(c) *Smell*.—The injury that may be inflicted on the olfactory nerve in fracture of the anterior fossa has already been mentioned. Sometimes after an injury to the head, although there may be no evidence of fracture, the sense of smell is lost. In such cases some contusion of the olfactory lobes has probably taken place.

(6) **Abnormal conditions of the urine** (traumatic glycosuria).—Since the experimental investigations of Claud Bernard on the production of glycosuria, considerable attention has been directed to the condition of the urine after injuries to the head. It was soon discovered that after a head injury sugar was sometimes present in the urine. It usually appears a day or two after the accident, and lasts about a week. In some cases, however, it may be present for two or three months. This traumatic glycosuria is probably never permanent.

As a rule, there is only a moderate amount of sugar in the urine. Sometimes there is marked polyuria without any glycosuria, or there may be polyuria at first, and sugar may appear later. Whether polyuria or glycosuria is present, thirst is usually a prominent symptom. Several explanations of this condition have been offered. Claud Bernard considered that the medulla oblongata was injured in the region of the vaso-motor centre, and that as a consequence of the vascular dilatation that followed, the portal circulation was increased. This led to an increased supply of sugar to the blood, and some of this excess of sugar was eliminated by the kidneys. Another view is that the medulla oblongata is injured by the violence of the injury, causing a disturbance of the glycogenic centre.

The knowledge of the existence of this glycosuria after head injuries aids us neither in diagnosis nor prognosis. In the treatment of such a case, the presence of sugar might lead us to diminish the carbohydrate portion of the patient's food.

(7) **Hernia cerebri**.—By the term *hernia cerebri* is meant a protrusion of the brain through an aperture in the skull and dura mater, so that the protruded portion remains connected with the rest of the brain.

Pathology.—When in a healthy animal a trephine hole is made in the skull and the dura mater is opened, no protrusion of the brain takes place; and if the scalp be then stitched over the trephine hole, there is no tendency for hernia cerebri to develop. The condition essential for the formation of a hernia cerebri is an increase in the intra-cranial pressure. A defect in the skull and dura mater may exist; but so long as the intra-cranial pressure remains normal, no hernia cerebri will form. We have already seen that the chief causes of increased intra-cranial tension are inflammatory exudations, extravasation of blood, œdema of the brain, and new growths. When the surgeon trephines the skull and opens the dura mater with a view to remove the cause of this pressure and finds he is unable to do so, a hernia cerebri frequently forms, although the dura mater may have been tightly sewn up.

After the removal of tumours of the brain, the circulation in that part of the brain is much interfered with, and a spreading œdema may form, leading to considerable intra-cranial tension and the formation of a hernia cerebri. In diseases of the cranial bones ending in necrosis, usually syphilitic, a defect in the skull is formed. If in such cases the dura mater becomes ulcerated and destroyed, the inflammatory condition may spread to the brain, and a hernia cerebri may form.

As a rule, however, hernia cerebri forms after a fracture of the vault of the skull. In a few cases the hernia forms immediately after the receipt of the injury; but in a great majority of cases it does not appear for days or even weeks after the accident. In those cases where the hernia forms immediately after the injury, the increase in the intra-cranial pressure is caused by the depression of the fractured bones and by the extravasation of blood. In such a case, provided no septic infection of the brain follows, the hernia soon subsides after elevation of the depressed bone and removal of any clot.

The ordinary hernia cerebri following a fractured skull rarely appears before the third day, and its appearance may be delayed for some weeks. In these cases the increase of intra-cranial pressure producing the hernia is always due to the presence of septic inflammation in the brain and meninges.

Pathological anatomy.—The rare form of hernia that appears immediately after the accident retains for some days the characteristic white appearance of brain tissue. After a time the circulation of blood through it may be interfered with, leading to œdema and disintegration of the mass. In some instances septic infection takes place, and the mass becomes infiltrated with inflammatory products.

The ordinary hernia cerebri appearing within a few days of the infliction of the injury is caused by a septic inflammation of the brain and meninges. The increased intra-cranial tension produced by the inflammation causes a portion of brain to protrude through the defect in the skull and dura mater. It forms a red, turgid, mushroom-shaped mass. As it increases in volume its base becomes constricted by the edge of the hole in the skull, and the circulation, especially the venous return, is interfered with, leading to œdema and sloughing of the tissue on the surface of the hernia. Owing to the inflammatory and œdematous changes, the brain tissue becomes disorganised, and after a time may be scarcely recognisable.

In some cases the mass seems to consist of nothing but inflammatory products, the original brain tissue having become disintegrated, and this is sometimes termed a false hernia cerebri. In its mode of origin, however, it differs in no sense from the ordinary hernia cerebri. At first the hernia may have a thin sac formed by the stretched arachnoid, but this thin membrane soon ruptures and remains only at the base of the tumour. The brain immediately beneath the hernia is infiltrated with inflammatory products, and

sometimes an abscess may form which still further increases the intra-cranial pressure, and consequently the amount of brain protruded. In those instances where the hernia cerebri does not appear until some weeks have elapsed after the injury, a localised collection of pus without any general inflammation of the brain is usually the cause of the increased pressure.

Symptoms and diagnosis.—The formation of a soft turgid mushroom-shaped mass a few days after the occurrence of a compound fracture of the vault of the skull is absolutely diagnostic of hernia cerebri (Fig. 565). At first the swelling has two features characteristic of all tumours connected with the cranial cavity:—First, pulsation synchronous with the arteries; secondly, expansion on forcible expiratory efforts, such as coughing, crying, etc. In the early days of its existence, reduction of the mass within the cranial cavity is possible by exerting gradual and firm pressure. Later, this reduction becomes impossible, and any attempt to do so may cause grave cerebral symptoms indicative of increased intra-cranial tension.



Fig. 565.—Hernia Cerebri. (From a case in the London Hospital.)

Still later, the protruded mass forms adhesions with the pericranium and scalp, and constitutes what may be called the fixed or adherent hernia cerebri.

Prognosis.—This depends upon the cause of the increased tension. If due to depressed bone and extravasation of blood with œdema as in the previous hernia the prognosis is good. When

due to septic inflammation of the brain the prognosis is bad, because such inflammation nearly always progresses to a fatal termination. It cannot be too strongly impressed upon the mind that the hernia is only a sign of intra-cranial mischief, and does not in itself constitute a disease. So far as published statistics are trustworthy, about 30 per cent. recover. In these, however, recovery is rarely complete. Owing to the damaging effects of the inflammation upon the brain tissue, serious interference with the functions of the organ may ensue, thus paralysing, motor and sensory, affections of speech, Jacksonian epilepsy, etc., may follow.

Treatment.—From what has been stated in describing the pathology of hernia cerebri, it is obvious that any treatment directed to the hernia itself is useless, if the intra-cranial mischief is still active. Slicing away the hernia or ligaturing its base can have little or no influence upon the progress of the intra-cranial mischief. The first indication is, if possible, to prevent the formation of the hernia by applying firm elastic pressure over the defect in the skull. It is

sometimes found, however, that, by this procedure, grave symptoms of cerebral compression may be produced. We must remember that the formation of a hernia cerebri may be most beneficial in relieving intra-cranial tension, and indeed that it may be necessary for the life of the patient. The formation of the hernia is, in fact, a safety-valve action, and any attempt to prevent its occurrence may only accelerate the patient's death from cerebral compression.

It is a well-known fact that a hernia cerebri has a much greater tendency to protrude through a small aperture than through a large one. The reason of this is obvious. The hernia is caused by pressure from within, and the smaller the aperture in the bony wall the less is the pressure relieved. It is certainly a rational proceeding to enlarge the aperture to a considerable extent as soon as there is evidence, from the formation of the hernia, of increased intra-cranial tension.

In this way the brain as a whole is relieved from pressure, and the harmful influence of the inflammatory mischief is much more likely to be lessened.

The treatment of hernia cerebri may be summed up in the following manner :—The protrusion of the brain through the defect in the skull is a safety-valve action, and relieves the rest of the brain to a certain extent from the increased tension. Our attention, therefore, must be directed to the relief of the intra-cranial pressure rather than to the hernia. The methods of treating the septic inflammation already described must be adopted. (*See page 132.*) If in spite of these measures the bulging of the brain continues, it is evident that the intra-cranial tension is rising. It is then advisable to enlarge considerably the aperture in the skull, so as to relieve efficiently the intra-cranial pressure. Strict antiseptic precautions must, of course, be maintained from the first.

Wounds and fractures of the frontal sinus.—The frontal sinus may be wounded by direct or indirect violence. In the former case a fall on to the region of the sinus, or a blow from a weapon are examples of the kind of injury.

Wounds of the frontal sinus by indirect violence are those in which fractures of the base of the skull extend into the wall of the sinus.

Fractures of the frontal sinus may be divided into two classes :—

- (1) Those in which the anterior wall only is injured.
- (2) Those in which the posterior wall is injured, either alone or in addition to a wound of the anterior wall.

It is important to recognise this distinction, because only in the second class of cases is there any danger to the meninges or brain. Fractures of the anterior wall are always caused by direct violence; those of the posterior wall may be caused either directly by great violence, or indirectly by being involved in fractures of the base of the skull.

Symptoms.—If the mucous membrane lining the sinus is ruptured, *surgical emphysema* is almost sure to follow, and this may spread over nearly the whole body.

After a wound of the mucous membrane the sinus may become infected with pyogenic organisms. If the communication with the nose is patent, the pus can escape ; if, however, this communication becomes blocked with swollen mucous membrane or granulation tissue, the pus collects and forms the condition known as *empyema* of the frontal sinus. The bone forming the wall of the sinus may share in the septic inflammation, and more or less *necrosis* may ensue. In these cases one or more sinuses usually form in the region of the forehead or in the roof of the orbit.

Where the posterior wall is wounded and septic infection follows, the meninges and brain are very liable to be involved.

Foreign bodies—such as bullets, lance-heads, etc.—may become lodged in the sinus, and if they are not removed, most extensive suppuration and necrosis may result.

Treatment.—Surgical emphysema is best treated by compression with a bandage. In fracture of the anterior wall alone no treatment is indicated unless there is very marked depression, when an incision should be made and the fragments elevated. If there is any reason to suppose that the posterior wall is depressed it must be explored, and any depressed fragments elevated. After wounds of the posterior wall the safest method of dealing with the wound is to plug the sinus with iodoform gauze. In this way an extension of septic material to the meninges is prevented.

FRACTURES OF THE BONES OF THE FACE AND JAWS.

The nasal bones.—These bones are always broken by direct violence, and the fracture, when the degree of force is moderate, is usually situated from one-quarter to one-half an inch from the lower margin of the bones ; with greater violence the upper and thicker part of the bones may be broken, together with the septum nasi and the nasal processes of the superior maxillæ. It is very seldom that the cribriform plate of the ethmoid bone is fractured ; indeed, with very severe violence the frontal bone is more likely to give way. This immunity enjoyed by the cribriform plate is probably due to the fact that the septum nasi is a very bad conductor of vibrations.

Symptoms.—Unless the patient is seen within a short time of the accident, there may be some difficulty in eliciting the symptoms of fracture—a difficulty caused by the tumefaction of the soft tissues, produced by extravasated blood, and increased still more by the fact that manipulation of an injured nose is very painful.

The *deformity* produced depends entirely upon the amount and direction of the force. The nose may simply be depressed, or may be deflected to one side, and if there be no swelling of the soft tissues, the sharp edges of the fragments, usually the lower end of the upper fragment, can be distinctly felt. By manipulating the nose, *crepitus* can be elicited, but it is important to bear in mind

that undue *mobility* is not a safe guide, owing to the elasticity and free movement possessed by the nasal cartilages.

Complications.—The most frequent complication is *epistaxis*, which, however, is generally easily arrested. If there be any symptoms present indicating injury to the brain, it is important to determine whether the epistaxis is due to fracture of the anterior fossa of the skull or not. *Injury to the brain* may be caused by the violence that produced the fracture of the nasal bones, and the latter must be regarded rather as a complication of the head injury than *vice versa*. *Surgical emphysema* is an occasional complication, and in order to prevent its occurrence, the patient should be warned against blowing the nose. If, however, sneezing should occur, the patient must be told to direct the current of air as much through the mouth as possible.

Treatment.—Unless treatment is prompt, more or less deformity is sure to follow, because fractures of the nasal bones unite very quickly. An anæsthetic is necessary in many cases, owing to the pain produced by effective manipulation of the fragments. It is important for the practitioner to bear in mind that the correction of deformity is of the greatest moment. A deformity of the nose often produces a ludicrous effect upon the features of the face, which may react very seriously upon sensitive minds.

By inserting a suitable instrument into the nose, such as an ordinary blunt-pointed director, or still better, a hernia director, and by manipulating the outer surface of the nose with the fingers of the other hand, one can generally reduce the deformity. If there be a tendency for the fragments to become depressed again and project into the nose, our methods of treatment are very unsatisfactory. Numerous methods have been suggested—many of them ingenious, but only a few that could be adopted with any measure of success. The discomfort produced by the presence of any kind of plug in the nose is great, and this discomfort is still further increased if the passage of air through the nose be stopped. This last objection can be obviated to a certain extent by inserting cannulæ around which the plugging material is packed. The chief obstacle to this treatment is the tenderness of the nasal mucous membrane. One of the functions of this membrane is to originate reflex acts for the expulsion of foreign bodies; and we find that if a plug is firmly pressed against the mucous membrane there is great uneasiness, accompanied by the discharge of mucus, muco-sanious, and after a time, purulent fluid.

If some kind of support from within is absolutely necessary, small pieces of lint, each having a string attached, should be well greased with vaseline, and inserted gently into the nasal fossæ.

In some cases it might be better to support the fragments by passing a pin from one side of the nose to the other, and leaving it there for a week or ten days (Mason).

When the tendency is for the fragments to project outwards, the deformity can always be controlled by simple means. The

employment of lint and strapping is nearly always sufficient to maintain the fragments in apposition.

Fracture of the septum nasi.—When the fracture of the nasal bones is a depressed one, the septum must be either fractured or displaced. As a rule, the injury to the septum is very slight and is overlooked. In some cases, however, the displacement is sufficient to cause considerable interference with the passage of air through the nose, and may give rise to chronic changes in the mucous membrane. It is sometimes very difficult, after having replaced the septum, to keep it in its proper position. The surest way is to plug the nasal fossa on each side of the septum, but the objections to this method have already been insisted upon. For the methods of treating permanent deflections of the septum, see the article on the DISEASES OF THE NOSE.

Fractures of the superior maxilla, malar bone, and zygomatic arch.—In all probability a fracture of the stout malar bone never occurs without fracture of some of the other bones of the face. In nearly all cases the superior maxillæ are fractured at the same time. In the same way the strong zygomatic arch is never fractured by itself, but is associated with fractures of the malar bone and of the upper jaw.

A systematic description of fractures of the *superior maxillæ* is impossible. No two accidents are exactly alike in their results. One or both maxillæ may be extensively comminuted, or the fracture may be limited to the nasal, alveolar, or orbital processes. On rare occasions the two maxillæ have been separated.

When the *malar bone* is broken, the fragments may project outwards, but more frequently they are depressed; and when the orbital plate of the superior maxilla is broken as well, the depressed malar bone may cause protrusion of the eyeball.

In the case of the *zygomatic arch*, the fracture is usually situated in that part of the arch formed by the zygomatic process of the temporal bone, and the fragments may be displaced either in an outward or in an inward direction. When the fragments project outwards, reduction is easy; when they project inwards into the temporal muscles, they may interfere with the movements of the lower jaw.

Complications.—In cases where great violence has been at work the skull bones may be fractured, and injuries to the brain may exist. In fracture of the alveolar process *loosening of the teeth* is not uncommon. In these cases the teeth should not be removed, but replaced in their normal position, and kept there by interdental splints, if necessary. *Hæmorrhage* from some branch of the internal maxillary artery, or from the main trunk, is not uncommon. *Secondary hæmorrhage* is by no means infrequent after extensive fractures of the upper jaw. Injury to the *infra-orbital nerve* sometimes occurs, leading to anæsthesia of a part of the cheek, or to neuralgia.

Treatment.—It is important to bear in mind that, however

comminuted the fracture may be, all fragments, even if only slightly adherent, should be preserved. It is an established fact that these comminuted fragments nearly always unite. If the fragments be in direct communication with the mouth, frequent washing of the oral cavity with antiseptic lotions and insufflation of iodoform powder is necessary. Owing to the great diversity of these fractures, the methods for retaining the fragments in proper position are manifold, and only the principles of treatment can be indicated here.

In many cases the fragments are not loose, and remain firm in their proper position, so that no apparatus is necessary.

When the *alveolar process* is fractured, the fragments can be kept in position by some form of interdental splint, or by wiring together the teeth by the methods that will be described in treating of fractures of the lower jaw. (See page 171.)

When the wall of the *antrum* is fractured and depressed, it is necessary to perforate the antrum through the canine fossa, and to introduce an instrument to force the wall outwards.

When there is *separation of the maxillæ*, a steel spring should be used, which passes round the back of the head, and terminates in front in two pads, which press upon the cheeks and force the maxillæ together.

When the *malar bone* is fractured and depressed, great difficulty may be experienced in replacing it. It may be necessary to make an incision, and to elevate the fragments with a suitable instrument.

In the case of fracture and depression of the *zygomatic arch* no treatment is necessary if the lower jaw can be used without any trouble. But if the movements of the lower jaw are interfered with, an incision should be made, and the depressed fragments must be elevated and kept in position by wiring, if necessary.

Fracture of the lower jaw.—With rare exceptions this fracture is brought about by direct violence. Among the most frequent causes are blows received on the jaw while fighting, either with the fist or with a weapon, a kick from a horse, and a fall from a height. Gunshot wounds may produce most serious fractures of the lower jaw, with great comminution of the bone. The extraction of a molar tooth is frequently associated with a slight fracture of the alveolar process, but these fractures seldom give rise to any trouble. The few cases of fracture by indirect violence are caused by muscular action—as, for example, a severe fit of coughing.

Seat of the fracture.—In over 90 per cent. of the cases the fracture is situated in the *body* of the bone. This is probably due to the fact that the body is more exposed to injury and less protected by muscles than the ramus. The most common seat of fracture is in the neighbourhood of the canine tooth and mental foramen, this being the weakest part of the bone. Fracture sometimes occurs through the *symphysis menti*. Fracture of the *ramus* of the lower jaw is comparatively rare. It generally occurs at one of three places—namely, the angle, the neck of the condyle, or the coronoid process.

Symptoms.—The symptoms characteristic of all fractures are usually well marked.

(1) *Deformity* is nearly always present when the fracture is in front of the masseter and internal pterygoid muscles. According to Hamilton, however, there is sometimes no deformity at all in fractures of the lower jaw.

The larger anterior fragment is displaced downwards, and the smaller posterior fragment outwards, so that it overlaps the anterior fragment. Sometimes, however, the converse exists, the anterior fragment overrides the posterior. According to Malgaigne, the fracture through the body is nearly always oblique, the anterior larger fragment being fractured at the expense of its internal surface, and the smaller posterior fragment at the expense of its external surface. Here again the converse is sometimes met with. The downward displacement of the anterior fragment is due to muscular action, chiefly the muscles passing from the lower jaw to the hyoid bone. The posterior fragment is drawn firmly upwards by the temporal, masseter, and internal pterygoid muscles, so that the teeth press against those of the upper jaw. The outward displacement of the posterior fragment may be, in part, caused by the action of the temporal and masseter muscles, but it is chiefly due to the direction of the violence causing the fracture.

When the neck of the condyle is fractured, the displacement is considerable, the condyle being drawn inwards and forwards by the external pterygoid, and the rest of the jaw deviating to the opposite side, owing to the unopposed action of the other external pterygoid.

In fracture of the coronoid process the displacement is not so great as one would expect. Owing to the prolongation of the tendon of the temporal muscle on to the body of the lower jaw, the fractured portion is not as a rule much displaced.

(2) The degree of *mobility* that is present depends upon the situation of the fracture. If it be situated in the usual position, the degree of mobility is moderate. When the ascending ramus, however, is fractured, there may be scarcely any mobility. The greatest amount of movement is present in a double fracture of the body, where the central portion is separated from the rest.

(3) *Crepitus* can nearly always be obtained.

(4) *Pain* is severe, as a rule. This may be due to the laceration of such sensitive structures as the gums, and may sometimes be increased by injury to the inferior dental nerve.

(5) Slight *hæmorrhage* from the mouth, due to laceration of the gums, is a frequent symptom.

(6) *Dribbling of saliva* is usually present, and is a source of considerable discomfort to the patient.

Complications.—If we exclude the effects of firearms, *wounds of the face* are met with only in very severe fractures, such as that caused by a kick from a horse. Such wounds usually heal very well, and with care in the treatment, but little deformity need result.

Severe *hæmorrhage* is very rare. As a rule, the inferior dental artery escapes injury. In one case of alarming hæmorrhage it was necessary to compress the common carotid artery with the fingers for nearly three hours before the hæmorrhage ceased. Secondary hæmorrhage, the result of septic processes interfering with the closure of the vessels, is seldom met with in the present days of antiseptic surgery.

Loosening and dislocation of the teeth are perhaps the most frequent complications. If the teeth are simply loosened, they should not be removed, as they usually regain their attachment. It is important to ascertain that no tooth is displaced and lodged between the fractured ends of the bones.

Septic inflammation of greater or less degree is usually present, because nearly all fractures of the lower jaw are compound, communicating through the lacerated gums with the cavity of the mouth. The septic process may be active in some confined space, and lead to the formation of an *abscess*. The bone may be involved in the septic inflammation, and more or less *necrosis* may result.

Injury to the inferior dental nerve is a rare accident. A few cases of paralysis of the nerve have been described, and occasionally neuralgia may develop some time afterwards.

Dislocation of the lower jaw, combined with fracture, is a very rare accident, only a few cases having been recorded.

Treatment.—The treatment of fractured jaw varies according to the extent and nature of the injury. In all cases, however, there are certain rules of treatment which must be rigidly observed.

(1) The displacement must be reduced, and, what is of especial importance, the correct position of the teeth must be restored.

(2) A thorough cleansing and, if necessary, scaling of the teeth. It is hopeless to try to prevent septic inflammation in these compound fractures if the teeth are covered with thick layers of decomposing tartar.

(3) Whatever method may be employed to fix the broken ends, it is important to keep the jaw absolutely at rest; therefore, the patient is forbidden to speak, and nourishment should be given in a liquid form. A convenient method for giving food is to fix an india-rubber tube on to a feeding cup, and to pass the tube into the mouth



Fig. 566.—Bandage for Fractured Jaw. The figure shows the manner of applying the four-tailed bandage in fracture of the jaw. (Pick.)

behind the last molar tooth. There is frequently a gap in the front part of the mouth where a tooth has been lost, through which the tube can be very conveniently passed.

(4) The cavity of the mouth must be kept as clean as possible, and attempts made to arrest decomposition by antiseptic mouth-washes and powders. For mouth-washes a saturated solution of

peroxide of hydrogen, or a solution of carbolic acid (1 in 80) is very useful. If decomposition is at all active, iodoform powder is our surest agent.

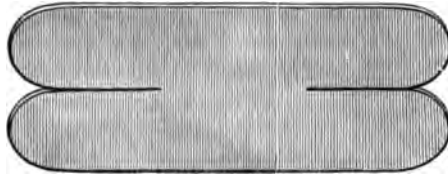


Fig. 567.—Splint for Fracture of the Lower Jaw. A piece of guttapercha cut into the proper shape for applying in a case of fracture of the lower jaw. (Pick.)

peroxide of hydrogen, or a solution of carbolic acid (1 in 80) is very useful. If decomposition is at all active, iodoform powder is our surest agent.

The methods employed to maintain the fragments in apposition are numerous, and

in the choice of a method the surgeon must be guided by the nature of the fracture and by the facilities for treatment at his service. *Bandages* are often employed. In simple uncomplicated fractures a four-tailed bandage is generally sufficient to keep the fragments at rest and in apposition, provided the rules above mentioned are adhered to.

It is made by taking a piece of strong calico bandage one yard in length and four inches in width, with a small slit in the centre for the chin to rest in; each end of the bandage is slit up to within three inches of the centre of the slit. Having placed the slit over the chin, the two lower portions of the bandage are tied over the vertex, and the two upper ones well above the occipital protuberance. (See Fig. 566.) To prevent slipping they may be tied together. In fracture of the lower jaw union is rapid, and towards the end of the third week slight movement may often be allowed, but no mastication should be permitted until the beginning of the sixth week.

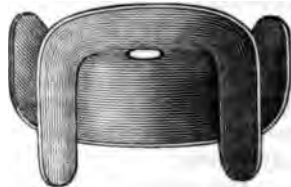


Fig. 568.—Splint for the Lower Jaw. The same piece of guttapercha as in Fig. 567, moulded into a splint, ready for application in a case of fracture of the lower jaw. (Pick.)

Splints.—If the support afforded by the simple bandage is not sufficient to keep the fragments in apposition, it may be advisable to try a *guttapercha splint* applied to the outside of the jaw. The objection to this splint is that it is apt to serve as a reservoir for the decomposing discharges of inflammatory exudation and saliva that are usually present. By cleansing and readjusting the splint every day or two, it may be used with benefit in certain cases. It is made by taking a piece of guttapercha about three inches broad and of sufficient length to extend from the angle of the jaw on one

side to that on the opposite side, and by bisecting it to within three inches of the centre on each side. (See Fig. 567.) By immersion in hot water, so as to make it soft, it is bent into the shape shown in Fig. 568, and accurately fitted to the jaw. A hole is cut to receive the chin. It is then lined with boracic lint, and kept in position by a four-tailed bandage.

In addition to the external splints there are various forms of splints employed within the mouth. By far the most useful of these is the *interdental wire-splint* devised by Mr. Hammond. Nearly all fractures that cannot be kept in position by the simple methods already described can be very satisfactorily treated by this method.

Unfortunately, however, it is never likely to be largely used by surgeons, unless the assistance of a dentist is invoked, because in order to make a successful wire-splint a considerable practical acquaintance with mechanical dentistry and manipulation within the mouth is necessary. In fractures requiring this method of treatment, it is the duty of the surgeon—unless he should happen to be well trained in work of this nature—to call in the aid of a dentist. The method of making this splint is best described by dividing it into five stages :—

1st stage.—The teeth must be thoroughly cleansed from all tartar, any decayed focus cleared out and the cavity temporarily filled. The mouth must be freed from mucus and saliva as much as possible, and washed out with a little eau-de-cologne or alcohol in water.

2nd stage.—A suitable “tray” must now be chosen and filled with soft wax. It is then placed in the mouth and an impression of the teeth taken, with the fragments replaced in their normal position if possible.

3rd stage.—From this soft impression a plaster-of-Paris cast is made. If the proper position of the teeth has been restored, we may at once pass on to the next stage. If, however, some displacement took place while the impression was being taken, the plaster cast must be divided at the seat of deformity and fixed together again, so that there is no deformity.

4th stage.—To the plaster cast the wire splint is accurately fitted by bending and hammering. This is done by taking a piece of iron wire and placing it round the row of teeth; at first in front of the row, then bending it round the last molar tooth on each side and carrying it round the back of the row of teeth, finally soldering the ends of the wire together.

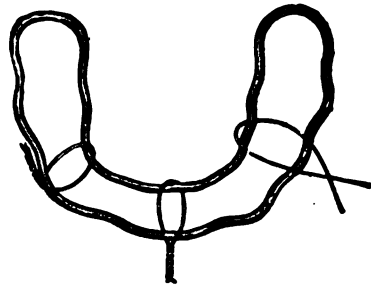


Fig. 568.—Hammond's Splint for Fracture of the Lower Jaw. The figure shows the collar of metal moulded to fit the teeth of the lower jaw, and the manner of tying the teeth to the metal collar. (Heath.)

5th stage.—The wire frame is now removed from the plaster cast and placed in the mouth, care being taken accurately to reduce the deformity. Then cut several pieces of soft iron wire—much thinner than that used for the frame—each about five inches long, and make one end of the wire rather pointed. These should be passed between the teeth, and made to surround them, as shown in Figs. 569, 570.

Various other forms of interdental splints have been used by Hamilton, Gunning, Angle, etc., but they are not so satisfactory as Hammond's.

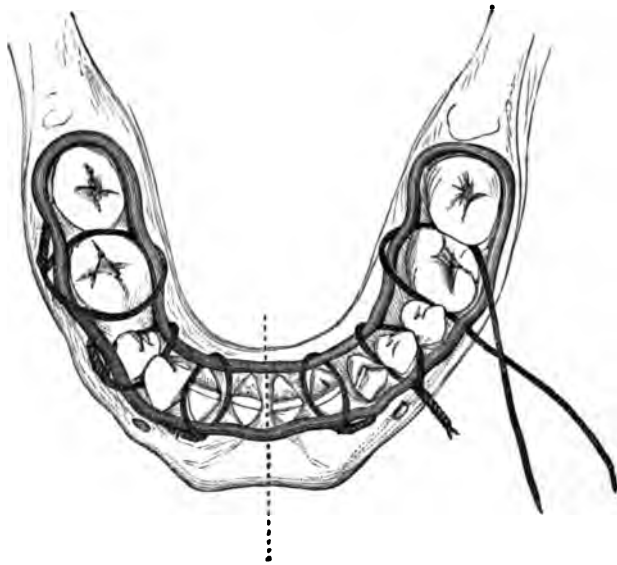


Fig. 570.—Hammond's Splint applied to the Lower Jaw (Heath.)

In addition to internal and external splints, there are splints that are partly internal and partly external. These are cumbersome, and have practically disappeared from modern treatment (Hayward's, Lonsdale's splints).

Ligature of teeth.—This method consists in fixing the fragments by tying together the teeth on each side of the fracture. The material used is either silk or wire. The control over the mobility of the fracture obtained by this method is by no means perfect, and a very grave objection to it is that the teeth around which the ligature is passed are apt to become loose, and the gum is often irritated.

Wiring of the fragments has been tried by several surgeons, and the best method is that described by Hugh Thomas of Liverpool. Thomas's method consists in drilling the fragments below the tooth-sockets, and then passing a piece of stout copper wire through the drilled holes, and bringing the fragments together by coiling the

copper wire upon a special "key" made for the purpose. During the treatment, the wire can be tightened from time to time.

Ununited fracture of the lower jaw is very rarely met with; it is, indeed, a surgical curiosity. In the same way union by fibrous tissue and the formation of a false joint is seldom met with. The treatment of the conditions differs in no respect from that employed in the treatment of ununited fractures generally. (See p. 794, Vol. I.)

XXXVII. DISEASES OF THE HEAD.

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DISEASES OF THE SCALP.

As a rule, diseases occurring in the scalp present the same characteristic features that are met with when they occur in other parts of the body. It will suffice, therefore, to draw attention to any special feature impressed upon the disease by its presence in such a region.

Inflammatory diseases.—**Cutaneous erysipelas** is identical in its general characters with erysipelas occurring in any other part. (*See* p. 157, Vol. I.) Its special interest, when situated in the scalp, is concerned with the cerebral complications which may, in some instances, develop. Thus, lepto-meningitis, intra-cranial abscess, and thrombosis of the intra-cranial blood sinuses are occasional complications. Sometimes the inflammation spreads to the orbit and may cause exophthalmos with subsequent optic atrophy, as in a case recently under my care in the London Hospital.

Only in rare cases has suppuration of the eyeball resulted.

There is nothing very special in the treatment of cutaneous erysipelas of the scalp. If any exophthalmos should supervene, the cellular tissue of the orbit should be incised, and any serum or pus must be evacuated before the pressure on the eyeball and optic nerve produces any serious change.

Cellulitis of the scalp is of special interest, apart from the danger of cerebral complications, only when it occurs beneath the epicranial aponeurosis, in the so-called "dangerous area" of the scalp. Owing to the slight attachment of the aponeurosis to the underlying pericranium, inflammatory exudation readily finds its way between these two structures and may completely lift up the scalp. The pus remains within the limits of attachment of the epicranial aponeurosis, and tends to point at the most dependent parts, namely, usually at the side of the scalp, either immediately above the zygoma or just behind the ear; less commonly in the frontal or occipital region. By early and free incisions at the most dependent points, taking care to avoid the main arteries of the scalp, and with

free drainage, the disease rapidly subsides. Owing to the great vascularity of the scalp it is seldom that any sloughing occurs. The pericranium may be destroyed over large areas of the bone without any necrosis of the latter taking place. The slight nutrient and osteogenetic functions of the pericranium have been already alluded to. (See page 134.)

Sinuses of the scalp resulting from previous cellulitis may be very intractable. This is probably due to the mobility of the epicranial aponeurosis, and in these cases Hilton's method of treatment is generally successful. This method consists in firmly strapping the scalp so that the occipito-frontalis muscle is kept at rest and the scalp is maintained in firm contact with the underlying bone.

Abscesses of the scalp are very numerous, and may be classified according to their cause or their situation. An abscess of the scalp may remain localised to one of the planes, or by extension may involve all of them. These planes are:—

(a) The dense tissue of the scalp superficial to the epicranial aponeurosis.

(b) The area beneath the epicranial aponeurosis.

(c) The area beneath the pericranium.

In tuberculous and syphilitic disease of the cranial bones, especially in the former, collections of purulent material frequently occur, forming the so-called "cold abscesses." These will be described in connection with Diseases of the Skull. (See page 184.)

Nearly all the other abscesses of the scalp are caused by various kinds of saprogenic micro-organisms.

When acute, and situated in the dense tissue of the scalp, they may be very painful.

Multiple abscesses of the scalp are common in children, especially in association with eczema and impetigo.

There is nothing special in the treatment of these septic abscesses. An incision into them with aseptic or antiseptic precautions, scraping out of the cavity and drainage, are sufficient. In the abscesses so frequently met with in children very rapid healing may be obtained by puncturing them in two places, scraping the interior with a small sharp spoon and applying elastic pressure.

Ulcers of the scalp caused by suppuration of wounds, by the extension of pustules, or of patches of eczema, call for no special description. They may be dismissed with the remark that all ulcers of the scalp have the potentiality of causing intra-cranial complications. The same remark will apply equally well to the syphilitic, tuberculous, epitheliomatous, and rodent ulcers. Boils, carbuncles, anthrax, and other inflammatory affections of the scalp call for no special comment.

Tumours of the scalp.—Tumours of the scalp may originate either in the connective tissue or in the epithelium and its appendages. Various tumours arising in connection with the vessels of the scalp are of considerable importance.

A. Tumours arising in connective tissue.—With the

exception of sarcomata these tumours are non-malignant in character. Sarcomata very seldom originate in the scalp itself, and present no special characters. The commoner tumours are the following :—

Fibromata.—These are of two kinds, the ordinary fibroma and the molluscum fibrosum. The *ordinary fibromata* are very seldom met with in the scalp, and may be pedunculated or sessile. If allowed to grow to any considerable size they may ulcerate and lead to septic complications. (See p. 458, Vol. I.)

Molluscum fibrosum of the scalp, sometimes called *elephantiasis* of the scalp or *pachydermatocele*, is a rare disease, consisting in an overgrowth of the skin and the subcutaneous tissue.

Its common seat is the occipital region, and it usually occurs in females (Vol. I. Fig. 108). It grows very gradually, is quite painless, and may reach an enormous size, forming huge pendulous masses as large as, or even larger than, the patient's head. The tumour is quite characteristic, and could not be mistaken for anything else. Sometimes



Fig. 571.—Lipoma superficial to the Temporal Fascia. (Sutton.)

molluscum fibrosum of the scalp may occur in the form of small discrete tumours.

Treatment.—If ordinary fibromata cause inconvenience to the patient they should be excised. In the treatment of molluscum fibrosum success has occasionally followed continuous pressure. Before the days of antiseptic surgery it was unwise to attempt their partial or complete removal.

At the present day, however, large portions of the growth can be removed without danger, so that the inconvenience may be diminished to a considerable extent. This treatment has superseded injections with iodine, etc.

Lipomata.—These tumours are occasionally met with in the scalp. In rare instances they are pedunculated. They are frequently situated under the epicranial aponeurosis, and in the

temporal region they have been found under the temporal fascia. The frontal region is a favourite site (Fig. 571). When situated beneath the temporal fascia it may be very difficult to recognise their nature. Occasionally they cause pain by pressing upon surrounding nerves, and in these cases they should certainly be removed.

In cases where there is no pain or inconvenience the question of removal can be left as a matter quite personal to the patient. (See p. 452, Vol. I.)

Myomata.—A case of myoma has been met with in the occipital region of the scalp of a female child three weeks old. When removed it was found to be encapsuled, and on careful microscopical examination it exhibited the characters of a myoma.

Angeliomata.—These may be divided into *naevi* and the plexiform angioma or cirroid aneurysms. (See pp. 462 and 577, Vol. I.)

(1) *Nævi*.—These are very commonly seated on the scalp and fall into three groups—

- (a) The capillary.
- (b) The cavernous.
- (c) The mixed.

Of these the pure cavernous is the least common. They may be situated at any spot, but show a decided preference for the fronto-temporal region. Virchow has pointed out that they tend to occur with special frequency in the region of the branchial arches, probably arising from the vascular tissue of those arches.

Thus a favourite site is in the fronto-nasal region, where in the fœtus the fronto-nasal fold unites with the mandibular arch, and in the auriculo-temporal region at the extremity of the first branchial cleft.

They present the usual characters of *nævi*.

In a few cases distinct pulsation may be present, and such a case might be difficult to distinguish from plexiform angioma (cirroid aneurysm). Indeed, we must remember that occasionally a *nævus* develops into a plexiform angioma, and there is probably every grade of transition between them. *Nævi* cause atrophy of the hair of the scalp, and may produce extensive changes in the underlying bone.

As regards treatment, the barbarous methods of ligature and the injection of coagulating fluids, etc., have practically disappeared from modern surgery. The methods usually employed at the present day for *nævi* of the scalp are excision by the knife and destruction by the thermo-cautery. The use of electrolysis in the treatment of *nævi* of the scalp is a tedious and generally unsatisfactory procedure.

A few words are necessary concerning *nævi* in the region of the anterior fontanelle. In the past, surgeons have avoided them until closure of the fontanelle, owing to the occasional occurrence of intra-cranial suppuration.

There seems no doubt that they may be in direct vascular

communication with the vessels of the meninges. With antiseptic precautions, however, the removal of these nævi is without danger, and may be performed as soon as convenient.

(2) *Plexiform angioma* (cirroid aneurysm, arterial varix, aneurysm by anastomosis, angioma racemosum).—These tumours are frequently termed cirroid aneurysms, but, with the exception of the name, and the fact that in both cases arteries are concerned, cirroid aneurysm and ordinary aneurysm have nothing in common. A plexiform angioma is a tumour formed by the aggregation of numerous dilated and tortuous arteries; sometimes the veins, and even the capillaries are involved in the disease. The favourite seat of these tumours is in connection with the superficial temporal, the occipital, and the facial arteries. The first two are by far the most frequently affected, hence the tumour, in its early stages, is nearly always limited to the forehead and scalp. They are usually present in early childhood, but frequently do not appear until adult life; they are occasionally congenital.

Ætiology.—The mode of origination of these tumours is very obscure. A history of previous injury is often given by the parents of the patient, or by the patients themselves, and many pathologists attribute the disease to the injury.

Although injury may possibly account for the development of these angiomas some time after birth, no such explanation can be accepted for those cases where the tumour is present at birth (congenital plexiform angioma). Virchow was the first to point out that this disease, like nævus, had a predilection for certain sites (*see* page 177), and his views have been still further elaborated by Heine, who considers that plexiform angiomas, at any rate the congenital ones, result from the dilatation of arteries in the cephalic visceral arches. Cases developing after birth are considered by Broca to originate, as the result of injury, in small congenital nævi which had escaped notice during infancy.

Pathological anatomy.—In the early stage the arteries begin to dilate and to increase in length, hence their tortuosity. The middle coat is found to be thickened, the increase in size being chiefly formed by connective tissue. Later, the middle and outer coats become atrophied, in some places more than in others, producing characteristic pouch-like dilatations. The component vessels have a great disposition to be arranged parallel to one another.

By the absorption of the walls of some of the pouches, neighbouring vessels are placed in communication with each other, and the aggregated mass of dilated arteries may, in some places, become transformed into a cavernous-like tissue. In the atrophied muscular coat there is evidence of fatty degeneration.

In some cases the veins appear to be little if at all affected. In other cases, however, they may be markedly dilated and varicose, and the capillaries are said to be occasionally involved in the disease. As the tumour increases in size the neighbouring tissues suffer.

The scalp over and around the tumour becomes atrophied, and the hairs drop out. Deep grooves may form in the underlying bone, and occasionally the latter is actually perforated.

Symptoms.—The appearance is very characteristic. The tumour forms a diffused spongy mass, with a peculiar uneven surface, and in advanced

cases there may be numerous rounded projections rising above the general level of the swelling. The skin over the tumour is usually bluish in tint, and a nævoid condition is often present. At the margin of the swelling the tortuous and dilated arterial trunks are more distinct than in the central embossed mass. Pulsation is generally very evident in the tumour, and this, together with the size of the swelling, may be diminished by compressing the chief trunks feeding it. By pressing upon the tumour it can be more or less emptied

of blood. With the stethoscope a murmur may be heard; usually loud and of a blowing character. In some cases the temperature of the skin over the tumour is raised from 1° to 2° F. In bad cases, giddiness and headache, or neuralgic pains, may distress the patient and prevent sleep. The condition generally tends to increase, and the tumour may, in rare instances, become very extensive, reaching down the neck to the clavicle (Fig. 572). It is stated that extension of the disease is favoured by the onset of puberty, and by high living and violent exercise. The symptoms



Fig. 572.—Plexiform Angioma, starting in the temporal region and gradually invading the neck. (Breschet.)

are frequently worse after each meal and during menstruation. As the condition advances the scalp becomes inflamed, and one of the vessels may be perforated, causing hæmorrhage, sometimes of alarming magnitude. In one case, where the skull was perforated, the blood escaped into the cranial cavity and caused fatal compression of the brain.

Diagnosis.—So characteristic is the appearance of a plexiform angioma, that confusion with other tumours of the scalp is scarcely possible. In slight cases there may be some difficulty in distinguishing it from a cavernous nævus, especially in those instances where, as we have already seen, a cavernous nævus may develop into a plexiform angioma.

Prognosis.—In some cases the tumour may remain stationary, especially if all injurious influences be warded off. As a rule, however, the tendency of the disease is to progress indefinitely, until repeated hæmorrhages, septic complications, or some intercurrent malady brings the patient's life to a close.

Treatment.—In the past the treatment of plexiform angioma has been most unsatisfactory. It was not until the condition was looked upon rather as a new growth than as an "aneurysm" that any uniform success was obtained. It is instructive to pass in review the various methods that have been employed.

(a) Continuous compression.—Direct pressure applied continuously for some time, in some cases as long as a year, is painful, dangerous, and unsuccessful.

(b) Ligation of the main arterial trunks.—Numerous observations have definitely proved that ligation of the main arterial trunks, whether of the innominate artery, of one or both common or external carotid arteries, or of the vessels immediately feeding the tumour, is dangerous to the patient and seldom of any utility.

(c) Destruction of the tumour.—Attempts have often been made to destroy the tumour by the application of various caustics, by the actual and galvanic cautery, and by other barbarous methods, without success.

(d) Methods to cause coagulation of the blood of the tumour.—This has been attempted with galvano-puncture, by the injection of perchloride of iron, and by the use of the obnoxious seton. The successes are few, and the dangers are many.

(e) Removal of the tumour.—Unless the tumour is very extensive, and in such cases no treatment is of any avail, removal of the tumour is the only rational method, and of recent years this line of treatment has been adopted with considerable success. The chief danger is that of hæmorrhage, and with care this need not be excessive. All the feeding-trunks of any size should be tied or secured by acupressure, or by direct pressure, and immediately afterwards the tumour should be excised; any feeding-vessel previously unsecured may then be picked up by forceps and tied. The raw surface should be covered as much as possible with grafts of epithelium according to the method of Thiersch. (See p. 577, Vol. I.)

(3) *Arterial aneurysms*.—These may occur in the scalp, and are nearly always traumatic in origin. The usual site is in some branch of the superficial temporal artery. Aneurysms of other scalp arteries are surgical curiosities. They present no special feature in their symptoms or diagnosis. The treatment is satisfactory, and consists in excising the sac and ligaturing the vessel at each end of it. (See p. 622, Vol. I.)

(4) *Arterio-venous aneurysms*.—When situated in the scalp they are always caused by some injury. They are very rare, and may simulate, to a certain extent, plexiform angioma.

The proper treatment is to ligature the vessels above and below the swelling, and then to remove the aneurysmal sac. (See p. 633, Vol. I.)

B. Tumours arising in epithelium and its appendages.

Papilloma.—

These frequently occur in the scalp, but present no special features. They may be much irritated by combing and brushing the hair, so that their early removal is strongly indicated.

Epithelioma.—Growths of this nature are not uncommon in the scalp, and do not differ in character from epithelioma occurring in other parts of the body. Early and complete removal, with Thiersch's skin-grafting, if necessary, is the proper treatment.

Sebaceous cysts (atheromatous cysts or wens).—These very frequently occur in the scalp, and may be very numerous. They are never in any way attached to the pericranium, nor do they cause any depression in the bone. The chief point of importance in the treatment is that every vestige of the cyst wall should be removed.

The best method is carefully to dissect out the cyst from the surrounding tissue. As a rule, this is a simple matter; but in cases where the cyst has become inflamed and where adhesions to surrounding structures have formed, it is by no means easy. In these



Fig. 573.—Cutaneous Horn: the widow Dimanche. (Sutton.)

cases the most thorough method is to remove some of the adjacent tissue with the cyst wall, and to excise an elliptical piece of skin over the most adherent part of the cyst. A method often recommended is to transfix the cyst by cutting from the deep surface towards the skin, and then to pull out with forceps the two halves of the cyst

wall. This method is objectionable, because it is impossible to prevent contamination of the wound by the possibly septic contents of the cyst.

Changes in sebaceous cysts. —

Sebaceous cysts may remain of small size, causing no inconvenience for years, and may even spontaneously disappear. In most cases, sooner or later, probably as the result of injury, the cyst becomes inflamed. This inflammation may subside without rupture of the cyst, but as a rule the skin over it becomes thin and finally gives way, allowing the septic contents to escape more or less completely.



Fig. 574.—Septic Granulation Tissue, spreading from a neglected sebaceous cyst. (Hutchinson.)

In other cases the contents may decompose and escape from an aperture in the skin, without any signs of inflammation. The decomposing contents may cause most offensive odours. By the escape of the contents of a sebaceous cyst through an aperture in the skin and the loss of moisture on exposure to the air, a firm horny structure may be formed, which tends slowly to increase in size by the gradual escape of the contents of the cyst. These are called *sebaceous horns*, of which a good example is seen in Fig. 573.

Inflamed sebaceous cysts, which have been allowed to burst, and

in which no treatment has been adopted, may form extensive ulcers. This ulceration is due to infection with septic micro-organisms, and may extend widely over the scalp, producing an appearance not unlike that of epithelioma (Fig. 574). This is sometimes termed "Cock's peculiar tumour," after the surgeon who first described it. It is important to bear in mind, however, that it is not a new growth but simply an extension of septic inflammation from a neglected sebaceous cyst.

Sometimes the suppurating sebaceous cyst may, if neglected, take on an epitheliomatous form of growth, and run the clinical course of ordinary epithelioma.

Dermoid cysts.—If we exclude the dermoid cysts met with at or near the outer angle of the orbit, those of the cranium are decidedly rare. They are usually situated in the region of the anterior fontanelle, and have been termed by Lannelongue *bregmatic or fontanelle cysts*. They are usually in the median line, and next to the anterior fontanelle they are most frequent in the region of the glabella. Occasionally they are present in the occipital region. When the cyst is not over a fontanelle, there is generally a fibrous band passing from the cyst through a hole in the bone to be attached to the dura mater.

In other cases, although the underlying bone may not be perforated, there is always a depression in the bone. It has been usual to ascribe this depression to the pressure exerted by the cyst upon it. Bland Sutton, however, explains the formation of the cysts in the following way: "Morphologically considered, the bony framework of the skull is an additional element to the primitive cranium, which is represented by the dura mater, and, as I have elsewhere endeavoured to show, the term extra-cranial should strictly apply to all tissues outside the dura mater. In surgical practice we find it convenient to regard the bones as the boundary of the skull, but morphologically this is inaccurate; the skull-bones must be regarded as secondary cranial elements. Early in embryonic life the dura mater and skin are in contact; gradually the base and portions of the side-walls of the membranous cranium chondrify, thus separating the skin from the dura mater. In the vault of the skull, bone develops between the dura mater and its cutaneous cap; but the skin and dura mater remain in contact along the various sutures, even for a year or more after birth. This relation of the dura mater and skin persists longest in the region of the anterior fontanelle, and in the neighbourhood of the torcular. Should the skin be imperfectly separated, or a portion remain persistently adherent to the dura mater, it would act precisely as a tumour germ, and give rise to a dermoid cyst. Such a tumour may retain its original attachment to the dura mater, and its pedicle become surrounded by bone: the dermoid would lie outside the bone, but be lodged in a depression on its surface, with an aperture transmitting its pedicle. On the other hand, the tumour may become separated from the skin by bone; it would then project on the inner surface, or between the layers of the dura mater.

"If this view of the origin of dermoids of the scalp be admitted, we must, then, slightly modify our teaching, and say that the depressions in which dermoids of the cranium are lodged arise as imperfections in the developmental process, and are not due to absorption induced by the pressure they exert; further, the fibrous connection of such dermoids with the underlying dura mater is primary, not accidental." (See p. 488, Vol. I.)

Serous cysts.—These are exceedingly rare, and their pathology is obscure. Some of them are possibly meningoceles, in which the communication with the dura mater has been interrupted by the development of bone across the hole. It has been suggested that some serous cysts have originated from hæmatomata.

DISEASES OF THE SKULL.

Inflammatory diseases.—It has been customary to describe as separate diseases inflammation of the pericranium, *i.e.* *pericranitis*, and inflammation of the bone itself, *i.e.* *cranitis*. When both structures were affected the term *osteo-periostitis* was used.

It has already been pointed out, however (see page 134), that the pericranium is by no means an important structure, and that it does not play such an essential part in the nutrition and regeneration of the bone as does the periosteum of the long bones. Owing to the slight importance of inflammation of the pericranium alone, it is better to discard the term *pericranitis*, and to include, under the term *osteomyelitis*, inflammations of the cranial bones and the membrane covering them. As a rule, *osteomyelitis* of the cranial bones is caused by septic infection taking place in a wound of the scalp or bone, and this may be termed *septic osteomyelitis*.

In a few cases, however, injury plays a small part, if any, in the production of the disease. The pathology and clinical features of these cases are similar to the cases occurring in the long bones, and may be termed *acute infective osteomyelitis*. (See p. 880, Vol. I.)

Chronic diseases of the cranial bones are sometimes a result of septic osteomyelitis. Thus, caries and necrosis of the cranial bones may follow an acute septic inflammation of them. The majority of chronic diseases, however, are due either to syphilis or tubercle. It will, therefore, be convenient to classify inflammatory diseases of the skull in the following way:—

1. *Osteomyelitis*—
 - (a) Septic osteomyelitis.
 - (b) Acute infective osteomyelitis.
2. *Tuberculous disease*.
3. *Syphilitic disease*.

1. (a) **Septic osteomyelitis.**—This is often met with after compound, depressed, and punctured fractures of the skull. Dirt, containing infective organisms, easily gets into the wound. The veins of the diploë become thrombosed, and the activity of the

micro-organisms leads to necrosis of a greater or smaller portion of bone. In these cases pus is very liable to accumulate between the dura mater and the bone, forming the subcranial abscess already described. (See page 132.) The treatment in these cases consists in vigorous antiseptics and free drainage.

(b) **Acute infective osteomyelitis or acute necrosis.**—It has frequently been denied that this disease can affect the cranial bones; and it has always been considered a disease peculiar to the long bone. There seems no doubt, however, that cases of acute infective osteomyelitis of the cranial bones do occur occasionally.

They run a course identical with the same disease of the long bones. Treatment must be prompt and energetic. Trephining in the inflamed area and free removal of the infected bone are necessary.

2. **Tuberculous disease.**—In former years cases of caries and necrosis of the skull-bones were either considered as diseases in themselves, or were attributed to the ravages of syphilis. At the present day we recognise forms of tuberculous disease of the cranial bones having very specific characters, and, as a rule, easily distinguished from syphilitic or other affections. These special characters are :—

That the disease commences in the bone itself.

That it secondarily affects the dura mater internally, and the pericranium externally.

That it is very chronic in its course.

That it is not accompanied by hypertrophic changes in the bone, i.e. there are no osteophytes or bosses as in syphilis.

There are three varieties of this disease.

(a) Tuberculosis perforans (Volckmann), in which a sequestrum forms, involving the whole thickness of the bone. This may separate spontaneously and leave a hole with smooth edges in the bone.

(b) In some cases the diploë and external table are destroyed over a small area without complete perforation.

(c) There is a third variety in which tubercular granulation tissue infiltrates the bone, and spreads widely between it and the dura mater. In my experience this is the most common form.

Symptoms.—These may be conveniently divided into three stages.

A. The latent stage.—In which no symptoms are complained of, or perhaps there may be slight uneasiness or tenderness in some part of the skull.

B. Abscess stage.—In which a slow-growing, painless, fluctuating swelling forms—a cold abscess, in fact.

By the time this stage is reached perforation of the cranial bone has generally taken place.

C. Sinus stage.—In which one or more sinuses are present, discharging a slight amount of pus—frequently foul-smelling, and surrounded by unhealthy granulation tissue.

Diagnosis.—The chief difficulty is in the abscess stage, to distinguish between a broken-down gumma and a tuberculous abscess.

The administration of iodide of potassium for a week may aid us in the diagnosis. Signs of syphilis or tubercle in other parts of the body should be looked for.

Treatment.—In my experience this is very satisfactory. If care



Fig. 575.—True Syphilitic Exostosis. (After Von Bardeleben.)

be taken to remove all the diseased bone the wounds generally heal up. In the infiltrating variety it may be necessary to remove a considerable amount of bone with a gouge forceps in order to scrape away the granulation tissue from the surface of the dura mater. As a result of this treatment large defects in the skull are

produced, and these should be protected by a suitable plate or cap.

3. Syphilitic disease. Acquired syphilis.—As a rule the lesions are more or less circumscribed and take the form of gummata. These may originate in one of three situations.

(a) Gummata arising in the pericranium.—These commonly commence in the secondary or early tertiary stage. They form hard or bone-like swellings or nodes which usually disappear very rapidly with appropriate treatment. They may become soft, and, if no remedies are given, they may finally break down and discharge their contents.

(b) Gummata arising in the bone itself.—These usually commence in the second year, but may arise at an indefinite time afterwards. They are not so amenable to treatment as the former variety, and frequently cause considerable necrosis.

(c) Gummata arising on the inner surface of the skull.—Gummata may originate on the inner surface between the dura mater and the inner table. They are less common than the other two varieties, and are more serious, because they may cause considerable interference with the functions of the brain.

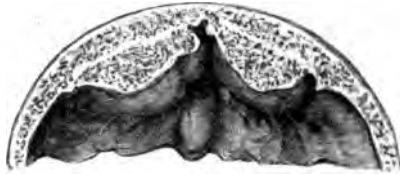


Fig. 576.—Syphilitic Exostosis, commencing in the Inner Table (Enostosis).

With the ordinary treatment for syphilis, all these gummata usually disappear and leave little or no trace behind them. In untreated cases, and sometimes in spite of active treatment, the bone becomes extensively diseased, and portions may even become necrosed. The gumma may then burst and leave a sinus leading down to a sequestrum; this sinus may become infected with micro-organisms, and septic osteomyelitis may be added to the syphilitic disease. In these cases the dangers of cerebral complications are

especially great. The cranial bones may be affected over very wide areas, leading to a characteristic worm-eaten appearance. (See Figs. 83 and 84, pp. 409 and 410, Vol. I.)

Sometimes gummata become converted into bony tumours, forming syphilitic exostoses. They may arise from the outer table only (the true exostosis), from the inner table only (enostosis), or from the diploë (parenchymatous exostosis). (See Figs. 575, 576, 577.)



Fig. 577.—Syphilitic Exostosis, commencing in the Diploë (Parenchymatous Exostosis).

Hereditary syphilis.—Gummata, especially of the periosteal variety, may occur in congenital syphilis. In addition, there

are two peculiar changes taking place in the cranial bones.

(a) *Atrophic.*—In which the bone, usually the occipital, becomes abnormally thin, or may even be perforated, forming a condition known as *craniotabes*. (See p. 367, Vol. I.)

(b) *Hyper-trophic.*—In which the bone becomes much thickened, especially around the anterior fontanelle, and on each side of the sagittal suture, forming the natiform cranium: Parrot's nodes.

Tumours of the skull. **Hydatid**

cyst.—There are only a few cases recorded, they are unilocular, and probably originate in the diploë. They may perforate the external table, exert pressure on the brain, and give rise to various symptoms of cerebral compression.

Complete removal of the cyst wall and its contents is the only satisfactory treatment.



Fig. 578.—Spontaneous Pneumatocèle. (Von Wernher.)

Spontaneous pneumatocele.—By this term is meant a tumour formed by a collection of air under the pericranium, and due to a perforation of the mastoid cells or of the frontal sinus, in which there is no definite evidence that injury played any part.

Nearly all the cases of pneumatocele have occurred in the mastoid region; only one or two cases have been recorded in connection with the frontal sinus. The changes leading to the perforation of the bone are very obscure; some suggest that chronic inflammatory changes of the nature of *caries sicca* have been the cause of the perforation.

It is presumed that, by the term "*caries sicca*," a non-suppurative tuberculous or syphilitic disease of the bone is meant. The tumour may attain considerable size suddenly, or its increase may be very gradual.

The tumour is tympanitic and contains slightly-altered atmospheric air, which has escaped from the air cavities of the frontal sinus or the mastoid cells. By pressure the tumour can be made to disappear, but on withdrawing the pressure it immediately reappears. They increase in size very slowly (Fig. 578).

Treatment.—Firm pressure over the tumour continued for some days or weeks will cure most of them. Failing this the question of operative interference must be considered. This has been much condemned, owing to septic complications that might arise. These, however, at the present day would be avoided with almost absolute certainty. The tumour should be incised, any carious bone chiselled away, and the cavity plugged with iodoform gauze.

Cephalhæmatocele.—By this term is meant a collection of blood, forming a tumour of the scalp, and communicating with one of the venous sinuses of the dura mater. In only a small minority of them is pulsation present. They are most commonly situated in the supra-occipital region; occasionally they are found over the frontal or mastoid bones.

At first the blood is limited externally by the pericranium, but, later, this structure may become atrophied, so that the outer limit is formed by the epicranial aponeurosis. Still later this structure may be perforated, and the wall of the tumour is then formed by the skin alone. The communication with the intra-cranial venous sinus may be of two kinds.

(a) *Direct*, in which there is a defect, both in the skull and in the wall of the venous sinus.

(b) *Indirect*, in which the communication takes place through an abnormal dilatation of the meningeal veins, or of the emissary veins of Santorini, or of the diploic veins.

In nearly all cases the tumour communicates with the superior longitudinal sinus. In those cases where the communication is direct, the tumour develops some time after birth, and may be caused by an injury, or may arise spontaneously. Those in which the communication is indirect are nearly always congenital, and they are probably, as Treves suggests, malformations of the venous system of the skull, veritable erectile tumours.

They form small tumours, which are nearly always reducible by pressure. Their communication with the cranial cavity is rendered evident by the fact that they expand when the patient coughs or makes any unusual expiratory effort. Only in rare cases is pulsation present.

As a rule, they give rise to no trouble, and do not tend to increase in size, so that no interference is called for. If, however,

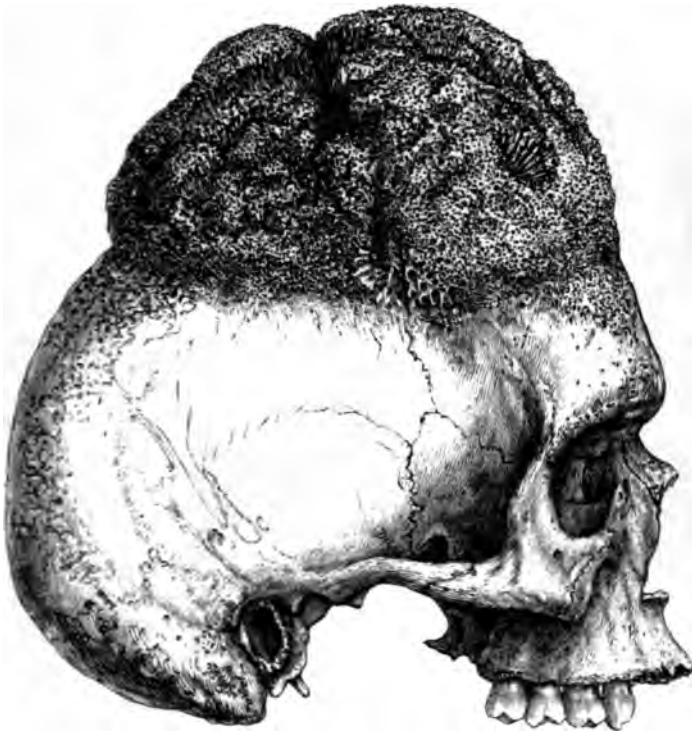


Fig. 579.—Ossifying Sarcoma of the Skull. (From a specimen in the Hunterian Museum.)

They are a source of annoyance to the patient, continuous pressure by means of a bandage should be tried. In the cases where the communication is direct, it is very unlikely that any operative procedure would be successful. By an osteo-plastic operation an attempt might be made to close the defect in the skull, and with proper precautions this would be devoid of danger. In the congenital cases electrolysis is sometimes successful. It might be possible to remove them, but the hæmorrhage from the dilated vessels in the bone might be difficult to arrest. The employment of aseptic wax would probably get over this difficulty.

"cracking" might be felt later. Neither of these signs, however, is of any constant diagnostic value. In the later stages of both varieties the skin is involved, the hair drops out, and the growth fungates through the skin. In rare cases the bone is completely invaded, and the growth spreads between the dura mater and the bone. The symptoms are those of a gradually increasing tumour, which is almost, or quite, painless at first. Later, it becomes painful, and if the bone be perforated, signs of intracranial pressure may arise. Removal of the growth with the segment of bone from which it is growing is the only satisfactory treatment; and to be successful this must be done in the early stage. In advanced cases death nearly always ensues from hæmorrhage, or from shock, or from a combination of the two. In Fig. 579 is represented an ossifying sarcoma commencing in the outer table.

Carcinoma.—This is always secondary to cancer in some organ of the body. Especially interesting are those pulsatile tumours of the vault of the skull and of other bones occurring in patients with enlargement of the thyroid gland (Fig. 580). On microscopical examination these tumours are found to be composed of tissue identical with that of the thyroid gland.

Fungus of the dura mater.—Simple tumours occasionally grow from the dura mater, but they are very rare. They are fibromata, lipomata, and osteomata. More common are *malignant growths*, which are usually secondary, and most often sarcomatous. They originate in the outer layer of the dura mater, and grow slowly, being surrounded by a distinct capsule, and by their pressure they cause atrophy of the superjacent bone, which is finally perforated. The growth then spreads more rapidly under the scalp, and finally an ulcerating and fungating mass is formed (Fig. 581). Very rarely sarcomata, which have originated in the arachnoid or pia mater, or even in the brain, may perforate the skull bones.



Fig. 581.—Fungus of the Dura Mater. Myxosarcoma commencing in the dura mater and perforating the skull. (Heineke.)

INFLAMMATORY DISEASES OF THE DURA MATER AND ITS SINUSES.

Pachymeningitis externa.—All the acute forms of this disease are septic in origin and may follow compound fractures of the skull, or may arise by extension from the middle ear in chronic suppurative otitis media. As a rule the external layer only is implicated, hence the term *pachymeningitis externa*. Sometimes, however, the infective organism may spread to the inner layer, forming *pachymeningitis interna*. In the former case the inflammation tends to remain localised to the area first infected, but when the inner surface of the dura mater becomes involved the inflammation tends to spread rapidly to the pia mater and arachnoid. We have already seen (*see* page 132) that after compound fractures, or even after wounds of the scalp, without injury to the bone, suppurative inflammation of the outer layer of the dura mater may take place and may render its presence evident by an œdematous swelling of the scalp (Pott's puffy swelling).

In other cases a subdural abscess may form, giving rise to symptoms of compression of the brain. (*See* page 133.) In the temporal bone septic pachymeningitis externa is very common, the infective material spreading from the middle ear. If the pus accumulates to any extent a subcranial abscess is formed. In other cases septic thrombosis of the sinuses or lepto-meningitis may arise.

The line of treatment is very obvious. The overlying bone must be removed by trephine, chisel, gouge forceps, or other suitable means, and the septic dura mater thoroughly exposed, irrigated and scraped with a sharp spoon if necessary. Free drainage is essential.

In *tuberculous disease* of the cranial bones the outer layer of the dura mater becomes covered with tuberculous granulation tissue, which, however, does not readily pass through the dura mater, but tends rather to spread upon the surface between the dura mater and the bone. I have noticed this tendency in several cases of tuberculous disease of the cranium in children, and sometimes it is necessary to remove a considerable area of the skull in order to scrape away the tuberculous material from the outer surface of the dura mater.

Syphilitic disease of the cranial bones may extend to the dura mater and cause a local syphilitic pachymeningitis externa, which may subside after removal of the carious bone, and the administrations of anti-syphilitic drugs. In cases of general pachymeningitis externa with symptoms of cerebral compression, trephining and incision of the dura mater, in order to relieve tension, may be indicated.

Pachymeningitis interna.—When septic in origin this disease always spreads either from the outer layer of the dura mater or from the underlying meninges. It never exists alone, and is only a sign of extension of inflammation from other parts.

Localised thickenings of the inner layer of the dura mater may be a result of syphilitic inflammation and may cause Jacksonian epilepsy.

Effusions of blood, not caused by injury, may be found upon the inner surface of the dura mater, sometimes so extensive as to merit the term *hæmatoma*. These effusions are probably the result of a previous inflammation, and the condition is usually termed *pachymeningitis interna hæmorrhagica*. In other cases a serous inflammatory exudation is found producing what is sometimes termed *hygroma of the dura mater*. In all of these conditions it is obvious that if any symptom of irritation or of compression of the brain be present, and some indication of the seat of the trouble be afforded, trephining and incision of the dura mater is the only treatment.

Infective thrombosis of the sinuses of the dura mater.—Thrombosis of the sinuses is of two kinds, *first*, the non-inflammatory form which usually occurs in patients suffering from marasmus or exhausting diseases, and is of medical rather than surgical importance; *secondly*, inflammatory or infective thrombosis, caused by the extension of micro-organisms to the walls of the sinuses. Non-inflammatory, or marasmic thrombosis, as it is sometimes called, scarcely concerns the surgeon, except, perhaps, from the point of view of diagnosis.

The most complete and accurate account of infective thrombosis is given by Macewen in his work on the "Pyogenic Diseases of the Brain and Spinal Cord," and to him I am indebted for much of the following description.

Etiology.—Infective thrombosis is always secondary to some local inflammatory lesion, and occurs in the sinus nearest to the seat of the lesion. The extension of the infective process may take place in two ways:—

- (a) By contiguity of tissue from the seat of the primary lesion, the organisms gradually extending until the wall of the sinus is reached.
- (b) By the infective thrombus extending along a small vein from the seat of the lesion to the sinus.

Among the numerous causes of infective thrombosis may be mentioned:—

1. Chronic suppurative otitis media, the most common cause. In this case the lateral sinus is the one infected.

2. Injuries of the head followed by septic inflammation occasionally lead to sinus thrombosis; e.g. in compound fractures, in simple fractures with bruised scalp, in septic wounds of the scalp, etc. The superior longitudinal sinus is the one commonly affected.

3. Acute inflammatory diseases of the face or scalp, such as anthrax, cutaneous erysipelas, cellulitis, etc., may lead to thrombosis.

4. Septic inflammation in the mouth, whether from the jaws and teeth, tonsils and other parts, or in the nasal fossæ. In these cases the cavernous sinus is the one commonly affected.

Pathology. (a) *Fate of the sinus.*—As the organisms invade

especially great. The cranial bones may be affected over very wide areas, leading to a characteristic worm-eaten appearance. (See Figs. 83 and 84, pp. 409 and 410, Vol. I.)

Sometimes gummata become converted into bony tumours, forming syphilitic exostoses. They may arise from the outer table only (the true exostosis), from the inner table only (enos-tosis), or from the diploë (parenchymatous exostosis). (See Figs. 575, 576, 577.)



Fig. 577.—Syphilitic Exostosis, commencing in the Diploë (Parenchymatous Exostosis).

Hereditary syphilis.—Gummata, especially of the periosteal variety, may occur in congenital syphilis. In addition, there

are two peculiar changes taking place in the cranial bones.

(a) Atrophic.—In which the bone, usually the occipital, becomes abnormally thin, or may even be perforated, forming a condition known as *craniotabes*. (See p. 367, Vol. I.)

(b) Hypertrophic. — In which the bone becomes much thickened, especially around the anterior fontanelle, and on each side of the sagittal suture, forming the natiform cranium: Parrot's nodes.

Tumours of the skull. **Hydatid**

cyst.—There are only a few cases recorded, they are unilocular, and probably originate in the diploë. They may perforate the external table, exert pressure on the brain, and give rise to various symptoms of cerebral compression.

Complete removal of the cyst wall and its contents is the only satisfactory treatment.



Fig. 578.—Spontaneous Pneumatocele. (Von Wernher.)

Spontaneous pneumatocele.—By this term is meant a tumour formed by a collection of air under the pericranium, and due to a perforation of the mastoid cells or of the frontal sinus, in which there is no definite evidence that injury played any part.

Nearly all the cases of pneumatocele have occurred in the mastoid region; only one or two cases have been recorded in connection with the frontal sinus. The changes leading to the perforation of the bone are very obscure; some suggest that chronic inflammatory changes of the nature of *caries sicca* have been the cause of the perforation.

It is presumed that, by the term "*caries sicca*," a non-suppurative tuberculous or syphilitic disease of the bone is meant. The tumour may attain considerable size suddenly, or its increase may be very gradual.

The tumour is tympanitic and contains slightly-altered atmospheric air, which has escaped from the air cavities of the frontal sinus or the mastoid cells. By pressure the tumour can be made to disappear, but on withdrawing the pressure it immediately reappears. They increase in size very slowly (Fig. 578).

Treatment.—Firm pressure over the tumour continued for some days or weeks will cure most of them. Failing this the question of operative interference must be considered. This has been much condemned, owing to septic complications that might arise. These, however, at the present day would be avoided with almost absolute certainty. The tumour should be incised, any carious bone chiselled away, and the cavity plugged with iodoform gauze.

Cephalhæmatocele.—By this term is meant a collection of blood, forming a tumour of the scalp, and communicating with one of the venous sinuses of the dura mater. In only a small minority of them is pulsation present. They are most commonly situated in the supra-occipital region; occasionally they are found over the frontal or mastoid bones.

At first the blood is limited externally by the pericranium, but, later, this structure may become atrophied, so that the outer limit is formed by the epicranial aponeurosis. Still later this structure may be perforated, and the wall of the tumour is then formed by the skin alone. The communication with the intra-cranial venous sinus may be of two kinds.

(a) *Direct*, in which there is a defect, both in the skull and in the wall of the venous sinus.

(b) *Indirect*, in which the communication takes place through an abnormal dilatation of the meningeal veins, or of the emissary veins of Santorini, or of the diploic veins.

In nearly all cases the tumour communicates with the superior longitudinal sinus. In those cases where the communication is direct, the tumour develops some time after birth, and may be caused by an injury, or may arise spontaneously. Those in which the communication is indirect are nearly always congenital, and they are probably, as Treves suggests, malformations of the venous system of the skull, veritable erectile tumours.

They form small tumours, which are nearly always reducible by pressure. Their communication with the cranial cavity is rendered evident by the fact that they expand when the patient coughs or makes any unusual expiratory effort. Only in rare cases is pulsation present.

As a rule, they give rise to no trouble, and do not tend to increase in size, so that no interference is called for. If, however,



Fig. 579.—Ossifying Sarcoma of the Skull. (From a specimen in the Hunterian Museum.)

they are a source of annoyance to the patient, continuous pressure by means of a bandage should be tried. In the cases where the communication is direct, it is very unlikely that any operative procedure would be successful. By an osteo-plastic operation an attempt might be made to close the defect in the skull, and with proper precautions this would be devoid of danger. In the congenital cases electrolysis is sometimes successful. It might be possible to remove them, but the hæmorrhage from the dilated vessels in the bone might be difficult to arrest. The employment of aseptic wax would probably get over this difficulty.

Angeioma.—Many cases described as angeiomata of bone have probably been vascular sarcomata, but excluding these, there is no doubt that simple vascular growths do occasionally occur. They are probably never troublesome enough to require surgical interference.

Osteomata.—These are bony tumours of the cranial bones, in which syphilis plays no part in their causation, and are quite distinct from the syphilitic exostoses already described. They are

of two kinds—the *ivory* and the *spongy or cancellous*—of which the former are by far the more frequent. In the ivory osteoma the bone is very dense, and can generally be readily distinguished from the surrounding bone; indeed, in some cases spontaneous separation has occurred.

They are most liable to occur in the frontal bone, especially in the region of the frontal sinuses. They may be confined to the



Fig. 580.—Pulsating Tumour of the Skull, associated with an enlarged thyroid. (Sutton.)

outer table, inner table, or to the diploë. They are of slow growth, and cause symptoms only by their pressure on the brain or eyeball.

Treatment.—Unless interfering with the functions of the eyeball or brain their removal is not advisable, unless the patient is especially anxious to get rid of the deformity. Ivory osteomata encroaching upon the eyeball or brain may sometimes be successfully removed.

Malignant disease.—Primary malignant disease of the cranial bones is always sarcomatous. Secondary growths may be either sarcomatous or carcinomatous.

Sarcoma.—This may commence in the pericranium or the diploë. Clinically, it is usually impossible to distinguish between the two. In the diploic variety, the tumour, in its early stage, would feel very hard owing to the bone covering the growth, and “egg-shell

cracking" might be felt later. Neither of these signs, however, is of any constant diagnostic value. In the later stages of both varieties the skin is involved, the hair drops out, and the growth fungates through the skin. In rare cases the bone is completely invaded, and the growth spreads between the dura mater and the bone. The symptoms are those of a gradually increasing tumour, which is almost, or quite, painless at first. Later, it becomes painful, and if the bone be perforated, signs of intracranial pressure may arise. Removal of the growth with the segment of bone from which it is growing is the only satisfactory treatment; and to be successful this must be done in the early stage. In advanced cases death nearly always ensues from hæmorrhage, or from shock, or from a combination of the two. In Fig. 579 is represented an ossifying sarcoma commencing in the outer table.

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Fungus of the dura mater.—Simple tumours occasionally grow from the dura mater, but they are very rare. They are fibromata, lipomata, and osteomata. More common are *malignant growths*, which are usually secondary, and most often sarcomatous. They originate in the outer layer of the dura mater, and grow slowly, being surrounded by a distinct capsule, and by their pressure they cause atrophy of the superjacent bone, which is finally perforated. The growth then spreads more rapidly under the scalp, and finally an ulcerating and fungating mass is formed (Fig. 581). Very rarely sarcomata, which have originated in the arachnoid or pia mater, or even in the brain, may perforate the skull bones.



Fig. 581.—Fungus of the Dura Mater. Myxosarcoma commencing in the dura mater and perforating the skull. (Heineke.)

INFLAMMATORY DISEASES OF THE DURA MATER
AND ITS SINUSES.

Pachymeningitis externa.—All the acute forms of this disease are septic in origin and may follow compound fractures of the skull, or may arise by extension from the middle ear in chronic suppurative otitis media. As a rule the external layer only is implicated, hence the term *pachymeningitis externa*. Sometimes, however, the infective organism may spread to the inner layer, forming *pachymeningitis interna*. In the former case the inflammation tends to remain localised to the area first infected, but when the inner surface of the dura mater becomes involved the inflammation tends to spread rapidly to the pia mater and arachnoid. We have already seen (*see* page 132) that after compound fractures, or even after wounds of the scalp, without injury to the bone, suppurative inflammation of the outer layer of the dura mater may take place and may render its presence evident by an oedematous swelling of the scalp (Pott's puffy swelling).

In other cases a subdural abscess may form, giving rise to symptoms of compression of the brain. (*See* page 133.) In the temporal bone septic *pachymeningitis externa* is very common, the infective material spreading from the middle ear. If the pus accumulates to any extent a subcranial abscess is formed. In other cases septic thrombosis of the sinuses or lepto-meningitis may arise.

The line of treatment is very obvious. The overlying bone must be removed by trephine, chisel, gouge forceps, or other suitable means, and the septic dura mater thoroughly exposed, irrigated and scraped with a sharp spoon if necessary. Free drainage is essential.

In *tuberculous disease* of the cranial bones the outer layer of the dura mater becomes covered with tuberculous granulation tissue, which, however, does not readily pass through the dura mater, but tends rather to spread upon the surface between the dura mater and the bone. I have noticed this tendency in several cases of tuberculous disease of the cranium in children, and sometimes it is necessary to remove a considerable area of the skull in order to scrape away the tuberculous material from the outer surface of the dura mater.

Syphilitic disease of the cranial bones may extend to the dura mater and cause a local syphilitic *pachymeningitis externa*, which may subside after removal of the carious bone, and the administrations of anti-syphilitic drugs. In cases of general *pachymeningitis externa* with symptoms of cerebral compression, trephining and incision of the dura mater, in order to relieve tension, may be indicated.

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Effusions of blood, not caused by injury, may be found upon the inner surface of the dura mater, sometimes so extensive as to merit the term *hæmatoma*. These effusions are probably the result of a previous inflammation, and the condition is usually termed *pachymeningitis interna hæmorrhagica*. In other cases a serous inflammatory exudation is found producing what is sometimes termed *hygroma of the dura mater*. In all of these conditions it is obvious that if any symptom of irritation or of compression of the brain be present, and some indication of the seat of the trouble be afforded, trephining and incision of the dura mater is the only treatment.

Infective thrombosis of the sinuses of the dura mater.—

Thrombosis of the sinuses is of two kinds, *first*, the non-inflammatory form which usually occurs in patients suffering from marasmus or exhausting diseases, and is of medical rather than surgical importance; *secondly*, inflammatory or infective thrombosis, caused by the extension of micro-organisms to the walls of the sinuses. Non-inflammatory, or marasmic thrombosis, as it is sometimes called, scarcely concerns the surgeon, except, perhaps, from the point of view of diagnosis.

The most complete and accurate account of infective thrombosis is given by Macewen in his work on the "Pyogenic Diseases of the Brain and Spinal Cord," and to him I am indebted for much of the following description.

Ætiology.—Infective thrombosis is always secondary to some local inflammatory lesion, and occurs in the sinus nearest to the seat of the lesion. The extension of the infective process may take place in two ways:—

- (a) By contiguity of tissue from the seat of the primary lesion, the organisms gradually extending until the wall of the sinus is reached.
- (b) By the infective thrombus extending along a small vein from the seat of the lesion to the sinus.

Among the numerous causes of infective thrombosis may be mentioned:—

1. Chronic suppurative otitis media, the most common cause. In this case the lateral sinus is the one infected.
2. Injuries of the head followed by septic inflammation occasionally lead to sinus thrombosis; *e.g.* in compound fractures, in simple fractures with bruised scalp, in septic wounds of the scalp, etc. The superior longitudinal sinus is the one commonly affected.
3. Acute inflammatory diseases of the face or scalp, such as anthrax, cutaneous erysipelas, cellulitis, etc., may lead to thrombosis.
4. Septic inflammation in the mouth, whether from the jaws and teeth, tonsils and other parts, or in the nasal fossæ. In these cases the cavernous sinus is the one commonly affected.

Pathology. (a) *Fate of the sinus.*—As the organisms invade

the sinus, the wall undergoes a gradual process of disintegration, and the endothelium is discharged into the lumen of the vessels. As the destructive process is taking place, the blood circulating through the sinus gradually coagulates; the clot being formed first on the part denuded of endothelium. The clot becomes firmly united with the disintegrating wall, and so hæmorrhage from the sinus is prevented. Immediately external to the wall of the sinus an inflammatory exudation collects.

In some cases this becomes organised, and may tend to strengthen the walls of the sinus. In the majority of cases the exudation becomes purulent and strips the sinus from the bone, leading finally to necrosis of the wall of the sinus.

(b) *Fate of the thrombus.*—Soon after the thrombus has formed it becomes infiltrated with micro-organisms, and by its disintegration produces a “greenish-brown, grumous particulate fluid” (Macewen). This fluid, teeming with organisms, finds its way into the general circulation, being swept into it directly from the sinus, or by means of tributary veins, or being taken up by the small vessels and perivascular spaces in the surrounding tissue. As a consequence of the dissemination of the micro-organisms, pyæmia may develop. Most of the particles are arrested in the minute vessels of the lungs, producing infarctions, pneumonia, abscess, and gangrene. Metastatic deposits in joints and other parts of the body may follow.

If the infective process be a mild one, the disintegration of the clot may be slight, and after a time repair will take place, and in the end the sinus become obliterated by fibrous tissue. On the other hand, the thrombus may rapidly extend and spread along the extra-cranial course of the vessel; in this way the upper third or half of the internal jugular vein may be affected.

(c) *Effects produced on surrounding structures.*—The thrombus, while disintegrating and before pus forms outside the sinus, produces in the neighbouring bone a dark greenish or brownish hue with a rough and eroded surface, which Macewen considers is probably due to the action of the bacillus pyocyaneus or other chromogenic organism. Later, a purulent exudation may form between the wall of the sinus and the bone which may spread into the bone, producing an infective osteitis and leading to extensive necrosis. When the other wall of the sinus, namely, that in contact with the brain, becomes surrounded by purulent exudation, the arachnoid and pia mater may become infected, and local or general lepto-meningitis is thus produced. When the thrombus is in the lateral sinus, basal lepto-meningitis is liable to form, and cerebral and especially cerebellar abscesses may be produced by extension of the organisms to the brain.

Symptoms and diagnosis.—The symptoms may be divided into two groups:—

(1) General symptoms caused by infective thrombosis of any of the intra-cranial sinuses.

(2) Local symptoms determined by special anatomical relations of certain of the sinuses.

General symptoms.—Unfortunately there is no stereotyped clinical picture of sinus thrombosis. In some cases characteristic local signs may be present, rendering the diagnosis easy; but according to the author's experience, the recognition of this condition is by no means a simple matter.

Headache is the most constant and the earliest symptom, and may be referred to any part of the head or to the region of the affected sinus.

Vomiting is very often present, and usually comes on early.

The pulse is very rapid, *e.g.* 120 to 150 per minute, and weak.

The temperature is nearly always raised, varying from 100° to 104° or 105° F., and is of the remittent type.

Rigors are usually present, and recur at varying intervals.

In addition to these symptoms, which are common to all cases of infective sinus thrombosis, there are other symptoms which Macewen divides into three groups:—

(a) The pulmonary type.—After a time, usually about the end of the second week, slight dyspnoea may indicate the onset of pulmonary mischief. Localised pain is complained of at one or more spots in the lungs, probably caused by the plugging of minute vessels and the formation of infarctions.

(b) The typhoid or abdominal type.—In other cases, towards the end of the second week "there is abdominal pain, meteorism, and diarrhoea. The stools are frequently pea-soup in character, and have a strikingly offensive odour. The skin is occasionally affected with a rather dark measly rash which does not disappear with pressure, and is not raised above the level of the skin" (Macewen).

(c) The meningeal type.—This type is seldom met with, and when present is generally associated with symptoms belonging to the other groups.

The meningitis may be secondary to the sinus thrombosis, or may be caused by the same primary lesion that produced the thrombosis. The symptoms are generally those of lepto-meningitis. Macewen is careful to point out that many cases of infective thrombosis cannot be relegated to one or other type, as they are most often mixed.

Local symptoms.—These will vary according to the sinus affected, and may be best described by taking each sinus *seriatim*.

Superior longitudinal sinus.—Local symptoms are, in the majority of cases, absent. Œdema of the scalp and swollen veins in the parietal, occipital, or frontal region may be present. The interference with the return of blood from the nose may cause epistaxis, especially in children. Convulsions, more or less general in character, may occur, and are followed by paralysis.

Cavernous sinus.—Thrombosis rarely arises primarily in the cavernous sinus. The chief cause is infective inflammation in the

orbit, which usually passes backwards along the ophthalmic veins. Infective inflammation in the nasal cavity is a rare cause. Inflammatory affections of the mouth or jaws, especially neglected alveolar abscesses, may lead to thrombosis extending backwards from the pterygoid plexus. The characteristic symptoms can be divided into two groups :—

(a) Local circulatory disturbances.—Owing to the venous obstruction, there is exophthalmos and œdema of the eyelids, and contiguous parts of the nose, forehead, and cheek. Chemosis is sometimes very marked.

(b) Local nervous disturbances.—The thrombus in the cavernous sinus presses upon the surrounding nerves, and may produce ptosis, squints of various kinds, and interference with the movements of the pupil.

Lateral sinus.—Very often there are no local signs when this sinus is blocked with a thrombus. Over-distension of the superficial veins, œdema over the mastoid region, and tenderness on percussion of the mastoid bone are usually mentioned as symptoms characteristic of lateral sinus phlebitis. The distension of the veins is not always present, and is not at all a certain guide. Œdema and tenderness on pressure in the mastoid region may be caused by suppuration in the mastoid bone without any thrombosis of the sinus, and these signs, therefore, are not of much diagnostic value. Again, enlargement of the deep cervical glands is sometimes present, but the appearance of this symptom may be delayed until late in the disease. The only absolutely diagnostic symptom is phlebitis of certain extra-cranial veins, especially the jugular and the posterior cervical venous plexus situated in the upper third of the posterior triangle. Great tenderness over these veins and the cord-like feel are characteristic of thrombosis in them. This symptom, however, is absent in many cases. According to some observers, the inflammation of the tissues around the lateral sinus and internal jugular vein may cause stimulation or paralysis of the vagus, shown by a slow or a rapid pulse respectively, and paralysis of the spinal accessory and hypoglossal nerves. Late in the course of the disease, abscesses may form under the deep fascia, around the internal jugular vein, or the posterior cervical venous plexus.

Prognosis.—Infective sinus thrombosis must be looked upon as a most serious disease. If not treated properly and promptly, death nearly always occurs. Occasionally, however, the infective power of the organism may be slight, and recovery may take place. Appropriate treatment in early stages of the disease affords good chances of recovery, and even in the late stages recovery is by no means impossible.

Treatment.—The fact that infective thrombosis is always secondary to a local inflammatory lesion has already been emphasised. The recognition of this fact is most important, because the attention of the surgeon should be directed to the prevention of the infection or the eradication of the primary focus.

Prevention of the infection.—In all injuries of the head, whether of the scalp, skull, or brain, every precaution must be taken to obtain asepsis. In cases of acute otitis media every endeavour should be made to prevent the case developing into chronic purulent inflammation.

Eradication of the primary focus.—If infective inflammation should have followed a head injury, the area of suppuration must be thoroughly exposed, irrigated with antiseptic solutions, and thorough drainage provided.

In chronic otitis media the condition of the ear should be carefully ascertained. A persistent attempt must be made to render the middle ear aseptic and to obtain healing. If the presence of septic granulation tissue and necrosed ossicles renders this impossible, they must be freely scraped away.

If there be any evidence of disease in the mastoid cells and antrum, an incision should be made behind the ear, and the antrum and the whole of the cells thoroughly laid open and scraped, so that all septic *débris* may be removed.

Operation to expose the mastoid antrum and cells.—A curved incision should be made one-third of an inch behind the insertion of the auricle from just above the base to the tip of the mastoid process. The periosteum is then reflected backwards and forwards for about half an inch. The position of the antrum varies considerably in different skulls, and the surgeon must bear this in mind when proceeding to open the antrum. For this reason the employment of trephines and drills for the purpose of opening the antrum is not advisable. One could only be sure of opening the antrum by these instruments if it were always in exactly the same position, and if our guides for it were always certain. By means of a gouge and mallet the operator can see exactly where he is going, and can easily avoid important structures in the neighbourhood. Macewen prefers a bur worked by a surgical engine. Dr. Cryer, of Philadelphia, has designed a bur which cuts bone with readiness, but will not in the slightest degree affect the soft tissues. By means of this instrument the antrum can be exposed in two or three minutes without any danger whatever. A convenient spot to open the bone is obtained by drawing a horizontal line along the upper margin of the meatus, and a vertical line a quarter of an inch behind the centre of the meatus; the point of meeting of these lines should be taken as the spot for perforating the bone. (See Fig. 583.) Having once entered the antrum, the mastoid cells can be readily opened up, and the communication of the antrum with the middle ear is readily found, and can be enlarged if necessary. Having removed all septic material the cavity should be thoroughly washed out and plugged with iodoform gauze. The cavity is allowed to granulate from the bottom, so that finally it becomes replaced by scar tissue.

The dangers of the operation are—wounding of the lateral sinus, or of the facial nerve, or of the labyrinth, and wounding the dura mater and brain in the temporal fossa. (See also page 309.)

Treatment of the infected sinus.—In the majority of cases the mastoid antrum and cells are in a condition of purulent inflammation. These should be exposed in the way already described, and all septic material removed. The most anterior part of the sinus, as it lies in the sigmoid groove, is most often affected, and therefore it is best to expose the sinus in this situation, which may be reached by perforating the bone at a spot in Reid's base-line $\frac{1}{2}$ to $\frac{3}{4}$ inch behind the centre of the external auditory meatus. Having exposed the sinus, any granulation tissue or purulent material around it should be scraped away. If there be any doubt whether the sinus is thrombosed or not, a small hydrocele trochar should be inserted, and if no blood escapes thrombosis exists.

Having decided that there is a thrombus, the operation suggested by Horsley, and successfully performed by Ballance, should be carried out. This consists in ligaturing the internal jugular vein in the neck so as to prevent the septic material in the sinus being swept along the jugular vein into the general circulation. It must be remembered, however, that the anterior and posterior condylar and other veins may allow portions of the septic clot being swept into the general circulation, even after ligature of the internal jugular vein. Having ligatured the internal jugular vein in the neck on a level with the hyoid bone, the wall of the sinus is incised and the septic thrombus scraped away. The wall of the sinus is then folded on itself, and the wound firmly plugged with iodoform gauze.

INFLAMMATORY DISEASES OF THE PIA MATER AND ARACHNOID.

Acute inflammation.—Acute septic inflammation of the pia mater and arachnoid has already been considered in the Article on INJURIES OF THE HEAD. (See page 129.)

Of recent years the possibility of successful surgical treatment of acute lepto-meningitis has been discussed. In the majority of these cases the immediate cause of death is cerebral compression. It is obvious that by trephining and draining the subarachnoid space, any increased cerebral pressure could be relieved. It seems probable, however, that the septic inflammation itself, apart from the pressure effects, has a uniformly fatal result. It is certainly worth while, however, to try the effect of trephining with drainage, and the answer of this important question must be left to the future.

In cases of *acute tuberculous meningitis* this line of treatment has been adopted with occasional success. In some of the successful cases that have been recorded, however, the tuberculous nature of the inflammation was by no means definitely proved. The methods of relieving intra-cranial pressure of this nature will be considered in the section on Hydrocephalus. (See page 211.)

Chronic inflammation.—As a result of injury to the

cranium a localised inflammation of the meninges may follow, and if situated over the cortex of the sensori-motor area attacks of Jacksonian epilepsy may indicate operation. (See page 215.) Excluding injury, syphilis is the most common cause of localised chronic leptomeningitis. Other forms of chronic meningitis, especially that caused by alcoholism, are of medical rather than surgical importance.

ABSCESS OF THE BRAIN.

It has already been pointed out that in cases of acute septic inflammation of the meninges the brain-substance is also involved in the process to a greater or lesser extent; hence the term *meningo-encephalitis*. Whether an acute diffused encephalitis may follow an injury without the meninges being also affected is extremely improbable. The interest of the surgeon in inflammatory diseases of the brain centres itself around *abscess*.

Ætiology.—All abscesses of the brain are caused by micro-organisms, but in many cases it is impossible to state the exact way in which the germs reached the cerebral substance. This question has already been discussed in the Article on INJURIES OF THE HEAD. (See page 128.) The causes of abscess of the brain are numerous.

(1) By far the most common cause is *chronic purulent otitis media*. The abscess may be situated in the temporo-sphenoidal lobe or in the cerebellum. They are rather more frequent on the right side than on the left. This is probably owing to the fact that the right lateral sinus is larger than the left, and, consequently, brings the tympanum and mastoid cells in closer relation with the brain.

Abscess in the cerebrum is three or four times more frequent than in the cerebellum.

(2) *Injuries of the head* may be followed by abscess of the brain, and the paths by which the septic material gains entrance have already been described. They are most common in the frontal and parietal regions.

(3) *Disease of the cranial bones*, especially syphilis or tubercle, may lead to abscess of the brain.

Necrosis of the upper jaw from phosphorus poisoning may be followed by abscesses in the frontal lobe.

(4) In *pyæmia* abscesses may form in the brain and are usually multiple. They seem to have a preference for the occipital lobes.

Abscesses in the brain, secondary to empyema or bronchiectasis, are not uncommon.

Pathology.—The inflammatory process may be very acute, and an abscess is formed with no distinct wall. These acute abscesses are rarely, if ever, secondary to otitis media, but usually occur as a result of direct septic infection by a punctured wound or by a compound fracture. More commonly the abscess is of gradual formation, and a distinct capsule separates the pus from the surrounding brain tissue. In the chronic abscess so frequently associated with otitis media the pus may smell offensively, and bacilli

have been found identical with those in the purulent discharge from the ear. The abscess may remain in a quiescent condition for considerable periods of time, and may then rapidly increase in size, killing the patient by the intra-cranial pressure that it exerts. In some cases it bursts into the ventricles of the brain, or on to the surface, causing a suppurative lepto-meningitis. In rare cases the pus may be discharged to the exterior, either into the ear by perforating the tegmen tympani, or through an erosion in the temporal bone.

Symptoms. (1) **The acute abscess.**—These abscesses, usually associated with punctured or compound fractures of the skull, give rise to symptoms very similar to those of meningitis; in fact, meningitis is often present at the same time. Intense headache with fever is the first definite sign. The temperature is usually high and rigors are frequent. Symptoms of cerebral compression rapidly develop, and the patient dies in a comatose condition in a period varying from one to three weeks from the infliction of the injury.

(2) **The subacute and chronic abscess.**—In the majority of cases the formation of pus is not so rapid as in the previous case. No sharp line of demarcation can be drawn between the sub-acute and chronic abscess. The chronic abscess may be present for some time without giving rise to any recognisable sign, and then, owing to a sudden increase in the activity of the inflammation, symptoms of cerebral compression may develop. In some cases, with scarcely any warning, the abscess suddenly bursts into the ventricles or on to the surface of the brain, causing a rapidly developed and fatal coma. As a rule, however, definite signs of an abscess are present for some days or weeks, or even longer, before grave symptoms arise.

Headache, persistent in character and generally localised to one side of the head, and *drowsiness* are the earliest signs. As a rule, the onset of *optic neuritis* can be detected early, but this is a very variable symptom, and may be absent during the whole course of the disease, or only develop towards the termination of the illness, when its diagnostic value is of little use. The *temperature* has generally a peculiar sub-normal character, with an occasional exacerbation reaching perhaps 103° or 104° F., and accompanied sometimes by a rigor (Fig. 582). *Vomiting* is usually present, and is very variable in its intensity. For some time these general symptoms may be the only ones, and unless there is reason to suspect abscess from the existence of otitis media, or the history of injury, etc., diagnosis at this stage is difficult and often impossible. In some cases the patient becomes comatose and dies without any symptoms that may aid us to localise the abscess. Usually, however, there is some guide to the position of the abscess.

(a) If in the temporo-sphenoidal lobe, the abscess may exert pressure upon the internal capsule and cause paresis or paralysis of the whole or a part of the opposite side of the body. An abscess in the left temporo-sphenoidal lobe may lead to interference with speech. It must be remembered, however, that an abscess in the

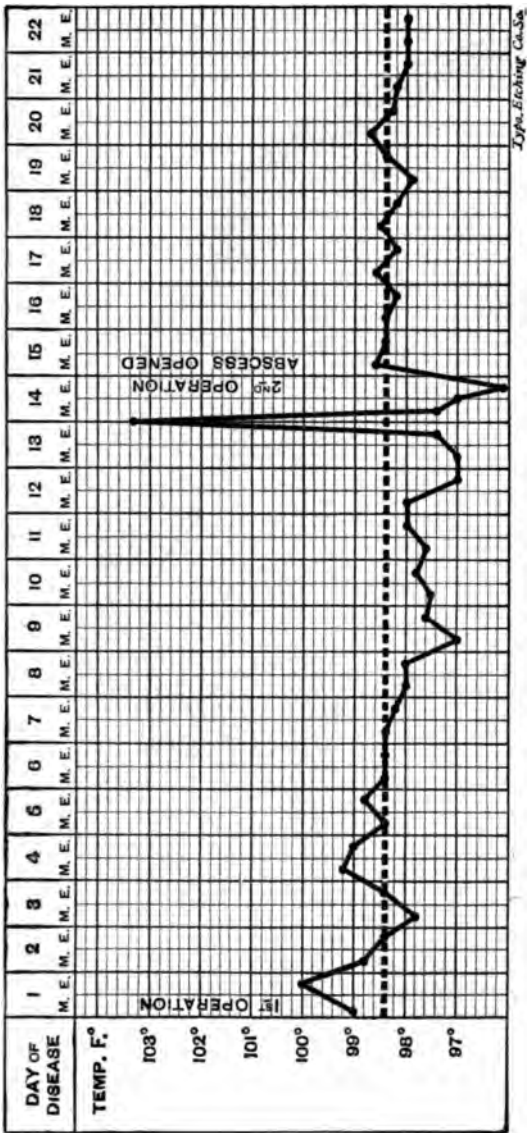


Fig. 582.—Temperature Chart in a case of Cerebellar Abscess successfully treated by operation. Notice the marked abnormal character of the temperature for the six days preceding the second operation, also the single rise of temperature to 103° the day before the second operation. After the second operation the temperature remained normal. A four-hourly temperature was recorded, but the chart does not show any more features of interest than the morning and evening one. The first operation consisted in cleaning out the mastoid cells.

temporo-sphenoidal lobe may be present without any symptom by which its situation can be ascertained.

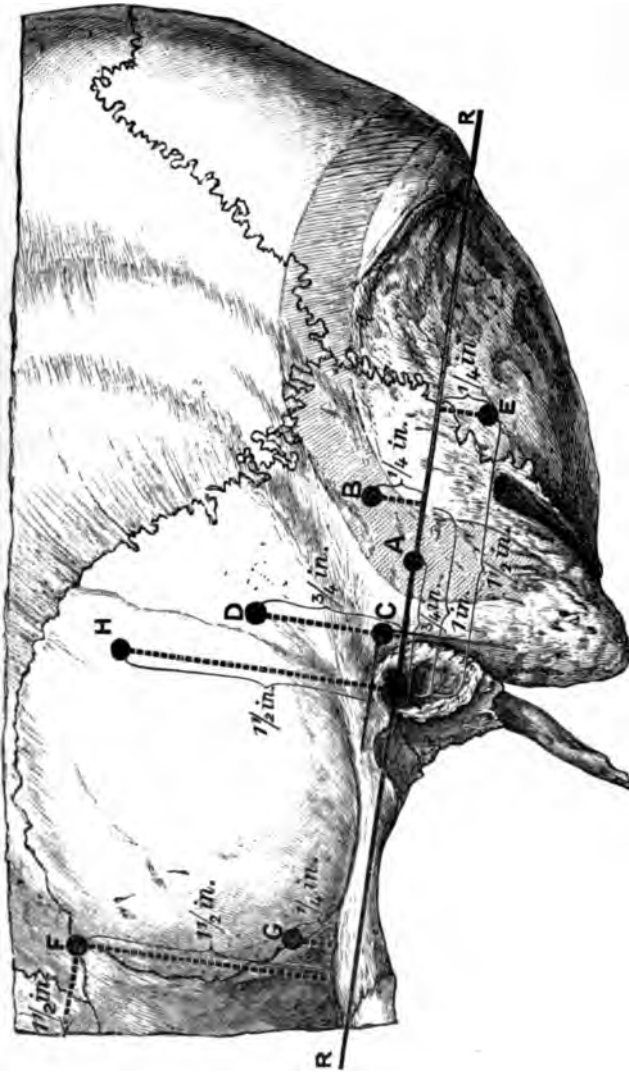


Fig. 583.—Diagram of Adult Skull (natural size), showing the various Points for Trephining. The horizontal measurements are taken along Reid's base line *h*, from the centre of the external auditory meatus; the vertical measurements are taken by drawing lines at right angles to the base line. *A*, The sigmoid portion of the lateral sinus, a point $\frac{1}{2}$ in. along the base line from the centre of external auditory meatus; *B*, the transverse part of the sinus, a point $\frac{1}{4}$ in. from external auditory meatus, and $\frac{3}{4}$ in. from the sigmoid portion of the lateral sinus; *C*, the centre of the external auditory meatus; *D*, the centre of the external auditory meatus, a point $\frac{1}{2}$ in. from the base line; *E*, the centre of the external auditory meatus, a point $\frac{1}{2}$ in. from the base line; *F*, the centre of the external auditory meatus, a point $\frac{1}{2}$ in. from the base line; *G*, the centre of the external auditory meatus, a point $\frac{1}{2}$ in. from the base line; *H*, the centre of the external auditory meatus, a point $\frac{1}{2}$ in. from the base line; *R*, the centre of the external auditory meatus, a point $\frac{1}{2}$ in. from the base line.

(b) If in the *cerebellum*, the optic neuritis is usually very intense and vomiting is markedly persistent. In the early stage, incoordination of the patient's gait may be noticed. Later, retraction of the head and symptoms indicating unusually severe

pressure upon the medulla oblongata, such as slow pulse and respiration, may suggest to us that the abscess is in the cerebellum. Several cases have been recorded in which there was paralysis of the muscles of the same side of the body as the lesion in the cerebellum. There is no satisfactory explanation of this fact.

(c) If in the *sensori-motor* area of the brain, the presence of convulsions or of localised paralysis may indicate the exact situation of the abscess.

Prognosis.—If the pus be not evacuated the prognosis is most serious, nearly every case ending fatally. If, however, the abscess can be opened and drained before the patient's condition becomes too critical, the prognosis is remarkably good. For instance, Macewen has operated upon nineteen abscesses with the wonderful result that eighteen recovered.

Treatment.—The line of treatment to be adopted in a case of cerebral abscess is obvious. As soon as the presence of pus is suspected, an effort should be made to evacuate it. If the position of the abscess be fairly definitely indicated, the opening in the skull should be made as near as possible to the abscess.

(a) In *temporo-sphenoidal abscess*.—As a rule, the pus is situated in that part of the lobe adjacent to the tegmen tympani or mastoid antrum. The bone should be perforated at a point $\frac{1}{4}$ in. behind, and $\frac{3}{4}$ in. above the centre of the external auditory meatus.

(b) In *cerebellar abscess*.—The bone should be perforated at a point $1\frac{1}{2}$ in. behind, and $\frac{1}{4}$ in. below the centre of the external auditory meatus.

(c) In *frontal abscess*.—If it is thought that the abscess is in the posterior part of the frontal lobe, an opening must be made in the temporal region over the suspected seat of the abscess. In abscess secondary to disease of the nose or facial bones, the anterior part of the frontal lobe is the usual seat of the pus, and in these cases the skull should be perforated about $\frac{1}{2}$ in. above the superciliary ridges.

(d) Abscesses in *other parts of the brain* are uncommon, and their position can seldom be determined. If the symptoms point to the sensori-motor area, the skull should be opened over that part of the area where it is thought that the abscess is situated. For the rules to aid us to open the skull in this region, the reader is referred to the section on topographical anatomy (page 96).

Author's operation for the intra-cranial complications of chronic otitis media.—In many cases, although the pus in the brain may be fairly obvious, yet it is impossible to say from the symptoms whether the abscess is situated in the temporo-sphenoidal lobe or in the cerebellum. This is especially the case when the abscess is on the right side of the brain.

In certain cases, however, when the pus is on the left side of the brain, some affection of speech may indicate that the temporo-sphenoidal lobe is affected. In many cases that lobe has been explored unsuccessfully, and at the *post-mortem* examination the

abscess has been found in the cerebellum, and conversely there are other cases where the cerebellum has been searched in vain, because the pus was situated above the tentorium. In these cases the surgeon has been deterred from exploring both regions, probably by several reasons. Chief among them is the fear that the second operation might cause serious shock, and perhaps death on the operating table. No doubt, also, the feeling of disappointment caused by the failure to find the pus at the first exploration has determined some surgeons to abandon the search.

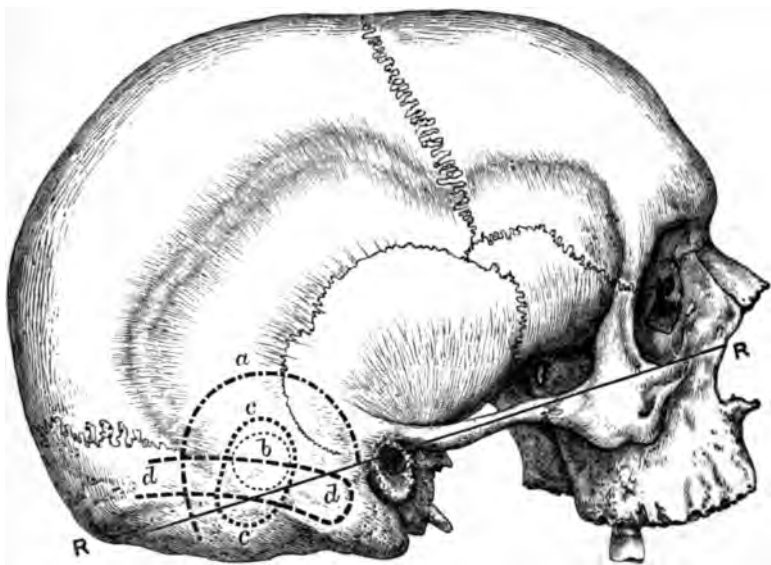


Fig. 584.—Sketch of an Adult Skull to represent an Operation for treating the chief intra-cranial Complications of chronic Otitis Media. (Reduced to one-half of natural size.)
a, Line of skin incision; b, pin of trephine placed $1\frac{1}{2}$ in. behind, and $\frac{1}{4}$ in. above, the centre of the external auditory meatus; c, area of bone removed by bone forceps; d, outline of the lateral sinus.

If we admit that in the majority of cases it is impossible to diagnose in which region the abscess is situated, the decision not to make a complete search for the pus cannot be justified by any argument. I have pointed out that in every case of cerebral abscess following otitis media, the surgeon can, with one skin flap, and with one opening in the skull, explore both the temporo-sphenoidal lobe and the cerebellum. It should be laid down as a rule that in all these cases the surgeon must be prepared before commencing the operation to search, if necessary, both above and below the tentorium. The bone should be perforated by a trephine or other suitable instrument at a spot $1\frac{1}{2}$ inch behind, and a quarter of an inch above the centre of the external auditory meatus. By this procedure a part of the lateral sinus, and the dura

mater just above it, are exposed. After slightly enlarging the hole upwards with a pair of sharp-cutting gouge forceps, the dura mater can be incised, and an exploration of the temporo-sphenoidal lobe satisfactorily carried out. If the pus be not found, the opening can be enlarged to a slight extent downwards and backwards, exposing the whole diameter of the lateral sinus and the dura mater for a small extent below it. By incising the dura mater at this spot, the cerebellum can be easily exposed within a few minutes of exploring the temporo-sphenoidal lobe. By referring to Fig. 584 it will be seen how small an area of bone need be removed in order to expose the temporo-sphenoidal lobe, cerebellum, and lateral sinus.

The operation need not last at the outside more than thirty minutes.

It is well known that in some cases it is impossible to diagnose cerebral abscess from meningitis. In both cases the most evident symptoms are due to cerebral compression, and it may be impossible to say whether the inflammatory exudation is localised or diffused. If, after exposing the brain, evidence of meningitis is present, and no pus can be found, the lateral ventricle should be tapped by inserting a trochar inwards and slightly upwards just above the lateral sinus. It is evident that the only satisfactory way of relieving the pressure caused by the inflammatory effusion of meningitis is to drain the lateral ventricle. The patient is dying from the effects of cerebral compression, and by relieving this pressure the only chance of recovery is given.

We have already seen that the symptoms caused by thrombosis of the lateral sinus may be vague and easily mistaken for those caused by abscess or meningitis.

Indeed, one of the latter conditions may be present with the lateral sinus phlebitis. It is evident that by this operation the lateral sinus can be easily examined. (*See page 198.*)

Differential diagnosis. Œdema and abscess of the brain, suppurative meningo-encephalitis and lateral sinus phlebitis.—To distinguish between these various affections is often a matter of extreme difficulty, and this is much increased when two or more of them are present at the same time, an occurrence by no means uncommon. With the exception of œdema of the brain, all of them are caused by the entrance of micro-organisms, and, therefore, some *primary septic focus*, from which the organisms invade the cranial cavity, is always present. *Headache* and *vomiting*, two of the classical symptoms of intra-cranial lesions, are usually present, varying in character and in degree.

A very localised headache may indicate an abscess or sinus thrombosis; but on the other hand, in both of these conditions the headache may be quite diffused. Vomiting aids us but little in the diagnosis, excepting when it is excessively persistent and violent, leading us to suspect a cerebellar abscess. The third classical symptoms—namely, *optic neuritis*—is never present in uncomplicated œdema of the brain and sinus thrombosis; it may be either present or absent in abscess or meningo-encephalitis.

By carefully looking for any *predisposing cause*, such as the situation and nature of a previous injury, or the existence of chronic suppuration in the neighbourhood of the cranial cavity, whether in the ear, the nose, or other region, some assistance in diagnosis may be derived. The pulse, when very slow, should lead us to suspect an intra-cranial abscess; if very rapid and very weak, sinus thrombosis must be thought of. A sub-normal temperature is in favour of abscess; a markedly remittent one suggests sinus thrombosis.

The following table may aid the reader in remembering the chief points of difference :—

<i>Symptom, etc.</i>	<i>Edema of Brain.</i>	<i>Abscess.</i>	<i>Suppurative Meningo-encephalitis.</i>	<i>Infective thrombosis of lateral sinus.</i>
1. The predisposing cause.	Severe shaking of the brain without wound of any kind.	Some wound from which organisms may invade brain, or chronic otitis media, etc.	Some wound from which organisms may invade brain, or chronic otitis media, etc.	Chronic otitis media.
2. Time of appearance of symptoms after injury.	About forty-eight hours, at latest fourth to seventh day.	No definite signs until after seventh day, often much later.	May commence on second or third day, usually about a week.	—
3. Mode of onset.	Sudden.	Variable.	Sudden.	Sudden.
4. Pulse.	Rapid.	Slow	Rapid.	Very rapid and weak.
5. Temperature.	Slightly raised.	Tendency to be sub-normal.	Persistent elevation.	Elevation with marked remissions.
6. Rigors.	Absent	Occasional.	Sometimes at onset of disease.	Frequent and severe.
7. Optic Neuritis.	Absent.	Usually present. (In very acute abscesses it may not have time to develop.)	Sometimes present. (These usually rapidly fatal, and so no time for neuritis to develop.)	Absent.
8. Mental irritability and excessive acuteness of senses.	Marked.	General drowsiness.	Marked with photophobia, etc.	Nothing characteristic.
9. Local signs.	Absent.	Absent.	Absent.	Thrombosis of internal jugular or posterior cervical veins.

TUMOURS OF THE BRAIN.

In no department of cerebral surgery has more advance been made than in the diagnosis and treatment of new growths of the brain. At one time nearly all tumours of the brain gradually progressed to a fatal termination, and alleviation of the pain by

drugs was by no means always successful. At the present day a small percentage of tumours can be successfully removed, and in a large percentage partial or complete alleviation of many of the symptoms is possible. Tumours of the encephalon occur with considerable frequency both in children and adults; if anything, they are rather more commonly met with in children. Of these tumours only a very small proportion can be removed.

They are those of the cortex cerebri and cerebellum, and, of course, growths of the meninges over the convexity of the brain.

Of all tumours of the brain about *seven* per cent. are capable of being removed.

The varieties of tumour are tuberculous and gummatous nodules, glioma, glio-sarcoma and sarcoma, carcinoma, cystic tumours, fibrous tumour of the dura mater, and psammoma.

The frequency of these tumours in children and adults is well shown in the following table compiled by Allen Starr :—

	CHILDREN.		ADULTS.	
	Cortex cerebri.	Cerebellum.	Cortex cerebri.	Cerebellum.
Tuberculous	13	47	9	8
Glioma	6	15	19	8
Sarcoma	1	10	46	13
Glio-sarcoma	—	1	8	6
Cystic	—	9	1	—
Carcinoma	1	3	9	—
Gummata	—	—	13	—
Uncertain	—	11	12	10
	21	96	117	45

Symptoms.—For a detailed account of the symptoms of tumours of the brain the reader is referred to special text-books on nervous diseases. There are three classical symptoms which are almost certain to be present some time during the course of the disease: they are *headache*, *vomiting*, and *optic neuritis*. In addition there may be

(a) *Symptoms of over-action*, such as Jacksonian epilepsy and subjective sensations or auræ.

(b) *Symptoms of want of action*, such as motor paresis or paralysis or sensory paralysis of various kinds.

It is very important to bear in mind the *progressive character of the symptoms*; there is a *slow but steady march from the earliest sign to the fatal termination*.

Treatment.—The presence of a cerebral tumour being suspected, the first question that arises is, whether any treatment short of operation can be of any avail. With the exception of tubercular and syphilitic tumours, no medicinal treatment seems to have any permanent influence over the growth. It is important to remember that iodide of potassium will temporarily arrest the growth, or even

cause a diminution in the size of any tumour of the brain whether simple or malignant. This may lead to a marked improvement in the symptoms, which, however, lasts but a short time. Considerable difference of opinion exists concerning the effect of iodide of potassium and mercury upon gummatous tumours of the brain; Horsley states that these drugs have no influence in such cases. As regards tuberculous tumours we find occasionally that the nodule may become quiescent and finally converted into fibrous tissue; during this process, however, the brain tissue may be much damaged, and the patient may become quite blind from the effects of optic neuritis.

If the operation for the removal of cerebral tumour is to be successful it must be performed as early as possible. It is, therefore, important to fix a limit for the employment of drugs which are producing no improvement or arrest of the symptoms, and this limit of time may be definitely fixed at two months.

In the case of malignant tumours we must look upon the question from the same point of view that we should look upon malignant disease in any other part of the body, namely, the chances of radical cure and the degree of palliation conferred by the operation.

(a) *The radical cure.*—In a very small proportion of cases only is a radical cure at all possible. A fibrous tumour of the dura mater or a psammoma, being simple tumours, would not be likely to recur, and the only question to discuss in these cases is, whether the tumour is of a size and in a position where it can be removed with safety to the patient's life. An exploratory operation alone can decide this question. There is no reason why a tuberculous nodule in the brain should not be treated like a tuberculous focus in any other part of the body that can be operated upon with safety, provided the nodules are not multiple. Successful cases of removal of tuberculous nodules from the brain have been recorded. With gliomatous and sarcomatous tumours radical cure has not yet been obtained. It remains to be seen whether these tumours can be completely removed by operating upon them at an earlier stage than is usually the case at present.

(b) *Palliative treatment.*—Apart from the fatal character of cerebral tumours the symptoms may be most distressing to the patient for a long period of time. Of these the most prominent are headache, vomiting, and the optic atrophy that so often follows the neuritis. It is found that by opening the skull, incising the dura mater, and relieving the increased cerebral pressure, which is the chief cause of these symptoms, the condition of the patient is generally much improved; the headache disappears, the vomiting becomes less marked, or even ceases, and the optic neuritis subsides in a complete and remarkable manner without any optic atrophy resulting.

In cases where the tumour is a large one, the question arises whether it is better to attempt its removal, or to be satisfied with simply relieving the intra-cranial tension. Complete removal

of these large tumours is nearly always impossible, and the risk of death from shock is very great, so that relief of the tension by removing a large piece of bone and opening the dura mater is a much safer proceeding, and is recommended in these cases.

MALFORMATIONS OF THE SKULL.

I. Hydrocephalus.—In its broadest sense hydrocephalus is a condition in which an abnormal amount of a watery fluid collects in the cranial cavity, so that the intra-cranial tension is raised above the normal, and as a result of this the skull becomes expanded. Some writers, however, restrict the term to cases where the fluid collects in the lateral and third ventricles, dilating them and causing more or less enlargement of the head. Adopting the wider significance of the term, it is convenient to classify them into acquired and congenital cases.

Acquired hydrocephalus.—Inflammatory conditions of the meninges and choroid plexuses may lead to an exudation of fluid, which may become so great as to distend enormously the ventricles of the brain.

If this effusion takes place during the period of growth an expansion of the bones of the cranium is produced. The formation of this fluid may take place with considerable rapidity, as in tuberculous meningitis or in septic lepto-meningitis.

The term *acute hydrocephalus* is consequently applied to this condition.

In some cases interference with the circulation of blood in the brain, e.g. pressure of a tumour upon the veins of Galen, or upon the straight sinus, may lead to an exudation of fluid. This takes place slowly, and may produce a marked enlargement of the head. The term *chronic acquired hydrocephalus* is applied to this condition. In other instances there is no apparent cause for the accumulation of the fluid, and these cases resemble the congenital ones, which will be described later.

As a rule, the fluid is collected chiefly in the ventricles of the brain, hence the term *hydrocephalus internus*; but occasionally there is a collection of fluid external to the brain, in the sub-arachnoid space, *hydrocephalus externus*.

Sometimes the fluid exists in both situations, which is simply a sign that the communications between the ventricles of the brain and the sub-arachnoid space by the foramina in the roof of the fourth ventricle are still patent. In tuberculous meningitis, and in tumours pressing on the veins of Galen, these apertures are frequently blocked, so that in acquired hydrocephalus the fluid is usually confined to the ventricles. In some cases there is a collection of fluid external to the brain, without any excess in the ventricles; this takes place in localised serous inflammatory effusions in the pia mater and arachnoid, and they have already been described as *hygroma of the dura mater*.

In cases of atrophy of the brain from marasmus and wasting diseases there may be an increase of fluid in the cranial cavity. This simply takes the place of the pre-existing brain matter, and does not cause any increased pressure, so that the condition cannot be looked upon as one of hydrocephalus.

In certain cases of microcephalus there is an increase of cerebro-spinal fluid, which is under a certain amount of pressure, so that the term hydrocephalus is applicable in these instances.

Congenital hydrocephalus.—This form is either present at birth or appears within a few months; in the latter cases the disease is no doubt congenital, but its existence is not evident at birth. In some cases the disease advances rapidly during intra-uterine life, and owing to the large size of the head considerable difficulty may be experienced in delivering the child.

Really nothing is known concerning the cause of the disease. By some, syphilis is thought to play a part; by others, alcoholism in the parents is said to be the cause. Our ignorance of its pathology is evident when we see the loose terms—essential dropsy, idiopathic effusion, etc.—applied to it in accounts of this disease.

The fluid usually collects in the lateral and third ventricles, and gradually produces an enormous dilatation. It is rare for the fourth ventricle to be dilated, the Sylvian aqueduct being obliterated in the majority of cases. Occasionally the collection of fluid may be very localised, being confined to one horn of a lateral ventricle or to the Sylvian aqueduct. The fluid contains a slight amount of albumen, and its specific gravity varies from 1006 to 1014. As the fluid collects and the ventricles dilate, the convolutions become compressed and form a thin layer. As a rule, the brain-tissue is tougher than normal, owing to an overgrowth of connective-tissue. Occasionally the corpus callosum becomes very much thinned by the pressure, and finally ruptures, so that a quantity of the fluid collects external to the brain in the sub-arachnoid space, and may press the convolutions towards the base of the brain.

Owing to the tension caused by the fluid the cranial bones become separated, the fontanelles are increased in size, and the skin over them bulges outwards.

The bones of the face retain their normal proportions, and as the cranium increases in dimensions the orbits are depressed. The contrast between the enormous cranium and the small face is very characteristic, producing the appearance sometimes termed *facies hydrocephalica* (Fig. 585).

Symptoms.—Gradual enlargement of the head may be the earliest symptom, but sometimes irritability with convulsions and squint may appear before any definite enlargement; instead of the irritability, the child may be dull and heavy.

As the disease progresses the intellectual faculties become impaired, or they may never properly develop.

Weakness or actual paralysis of the limbs may follow, and loss of function in the organs of special sense. Optic atrophy is very common.

Diagnosis.—This can only be a matter of difficulty in the early stages of the disease. The enlargement of the head, so common in *rickets* or the rare condition known as *hypertrophy of the brain*, can usually be readily distinguished. In *acquired* cases caused by meningitis or new growths there are generally symptoms pointing to the condition.

Prognosis.—The majority of cases steadily progress to a fatal termination. In a very small proportion the disease stops, leaving more or less impairment of the functions of the brain. In some cases progressive enlargement ceases for a time, only to start again later.

Treatment.—For the treatment of so-called acute hydrocephalus, the reader is referred to the remarks on tuberculous meningitis. (See page 198.)

In ordinary hydrocephalus various methods of treatment have been tried. *Aspiration* and *compression* under strict antiseptic precautions will relieve the intra-cranial tension for a time, but the fluid soon collects again, and the aspirations must be repeated. This treatment does not aim at removing the cause of the disease, but simply relieves the brain from the injurious effects of intra-cranial tension. A few successful cases have been reported; but so few, that one cannot help thinking that they were mild cases, in which the disease would have become, in any circumstances, arrested spontaneously.

Continuous drainage of the fluid, either by inserting a tube into the lateral ventricle or by draining the sub-arachnoid space at the base of the brain, has been tried. As a rule, the symptoms of impairment of cerebral function improved for a time, but the drainage has no influence upon the progressive character of the disease. I have tried the treatment of draining the lateral ventricle in twelve cases, and although temporary improvement was obtained in nearly all, the cases terminated fatally within a few weeks.

Whatever may be the cause of the increased exudation of fluid, whether tuberculous or septic meningitis, or ordinary hydrocephalus, the *methods of draining* the fluid are similar.

(1) *Aspiration.*—This can only be performed in children in whom the anterior fontanelle is not closed. A needle connected with an aspirator, or a small trochar, is rendered aseptic, and after careful cleansing of the scalp, it is thrust into the dilated ventricle at the side of the anterior fontanelle so as to avoid the longitudinal



Fig. 585.—Chronic Hydrocephalus.

sinus. Fluid is allowed to escape until the anterior fontanelle becomes slightly depressed, when the trochar is withdrawn. This process is repeated as soon as the bulging of the fontanelle indicates increased pressure.

(2) *Trephining*.—In cases where the fontanelle is closed it is necessary to perforate the bone with a trephine or other suitable instrument, and even if the fontanelle is not closed it is better, if continuous drainage is required, to perforate the skull lower down rather than through the anterior fontanelle. There are several ways of draining away the fluid; the lateral ventricles may be tapped, or the sub-arachnoid space may be opened up in one of three situations, namely, over the convexity of the brain, in the inferior cerebellar fossa, or in the Sylvian fissure. Finally, the spinal sub-arachnoid space may be opened up in the lumbar region.

(a) *Draining the lateral ventricle*.—The skull should be perforated at a point $1\frac{1}{2}$ inch vertically above the centre of the external auditory meatus; in children a less distance should be taken. By incising the dura mater, the second temporo-sphenoidal convolution is exposed, and a trochar thrust directly inwards for a distance varying from 1 to $1\frac{1}{2}$ inch. A small tube, or strands of silk or catgut, may be inserted for drainage.

(b) *Draining the sub-arachnoid space in the cranium*.—This has been performed in the interval between the cerebellum and fourth ventricle, but owing to the liability there is to injure the medulla oblongata, the operation is not devoid of danger. An incision is made to one side of the middle line just below the curved line of the occipital bone.

A flap containing all the soft structures is turned downwards, the bone trephined, and the dura mater incised. The lower border of the cerebellum is found and a director is pushed forwards beneath it until the sub-arachnoid space is perforated. This is shown by a sudden escape of cerebro-spinal fluid.

A safer place for drainage is to open the dilatation of the sub-arachnoid space at the commencement of the fissure of Sylvius.

The skull should be perforated at a spot half-an-inch behind and a quarter-inch above the external angular process of the frontal bone, and the dura mater and arachnoid incised. The sub-arachnoid space can be opened at any part of the convexity of the brain. A disc of bone is removed, a small piece of the dura mater excised, and an aperture made into the arachnoid membrane.

(c) *Draining the sub-arachnoid space in the spinal canal*.—This can be done by means of an aspirating needle thrust between two of the vertebræ of the lumbar region. If permanent drainage is required, the theca vertebralis must be exposed, and it, together with the arachnoid, incised.

It is important to remember that this department of surgery is purely in an experimental stage, and any definite statement concerning the effects of draining the sub-arachnoid space cannot be made.

II. Congenital cephalocele.—By the term congenital cephalocele is meant a malformation of the skull and brain in which a portion of the brain or of its membranes projects towards the exterior through a deficiency in the skull. Acquired cephaloceles have been already considered under the heading, *Hernia cerebri* (page 160). According to the contents of the prolapsed portion, cephaloceles are divided into three kinds.

(a) *Meningocele*.—In which the membranes of the brain only and cerebro-spinal fluid are contained in the tumour.

(b) *Encephalocele*.—In which a part of the cerebrum or cerebellum is in the sac.

(c) *Hydrancephalocele*.—In which a part of the cerebrum, together with a portion of a distended lateral ventricle, is in the sac.

Ætiology and pathology.—Numerous explanations have been offered of the formation of these peculiar tumours. Various diseases of the foetus during intra-uterine life have been suggested; e.g. arrest of ossification of the bones of the skull, premature ossification, hydrocephalus, etc. There is no definite evidence in favour of these views, and it seems more likely that the abnormality is due to an error of development commencing in the early days of embryonic life. This mal-development is an incomplete formation of the membranous layer which becomes ossified to form the skull, and the deficiency consists chiefly in the failure of union of the two halves. A similar error in development may occur in the vertebral column, producing a spina bifida, and the two deformities are probably identical in their mode of origin. The cause of this failure is a difficult matter to decide. It has been suggested that adhesion of the amnion to the embryo, and the pressure exerted by this union, may be the cause.

Pathological anatomy.—The situation of the majority is in the middle line, most frequently in the occipital region, and next to that in the fronto-nasal suture. In the region of the anterior fontanelle, or of the metopic suture, cephalocele is uncommon, and is very rare projecting through the base of the skull into the mouth or nose. Cephaloceles occasionally occur away from the middle line; thus, at the internal or external angle of the orbit, in the parietal region, in the orbital fossa, etc.

The *sac wall* is formed by the tissues of the scalp, and by the meninges. The scalp tissues may be normal or may be altered in various ways; for instance, the skin may become very thin, and with slight inflammatory action completely disappear, exposing the meninges. A nævoid condition of the skin is not uncommon. Internal to the scalp the sac wall is formed by dura mater and arachnoid, the latter in some cases being unrecognisable owing to its firm union with the dura mater. Sometimes there is a distinct layer of fluid between the two membranes.

The *contents* vary according to the variety of cephalocele. In *meningocele* there is simply a collection of cerebro-spinal fluid; in *encephalocele* there is some part of the cerebrum or cerebellum, with

a slight amount of fluid beneath the arachnoid and in the meshes of the pia mater.

The brain-tissue is altered in appearance, and there may be a part of the lateral ventricle in the prolapsed mass; in *hydrencephalocoele* some part of the cerebrum is prolapsed, with a prolongation of the lateral ventricle, which in these cases is distended with fluid (Fig. 586).

Symptoms.—The presence at birth of a regular hemispherical or pedunculated globular tumour, usually situated in the middle line of the frontal or occipital regions, is very characteristic. The skin over it is tightly stretched, and is often more or less adherent to the tumour. It is thin and smooth, and hair is not well developed over the summit of the tumour. Occasionally the skin presents a nævoid condition, or may be ulcerated to a considerable degree.

The fact that the tumour is in communication with the cranial cavity is rendered evident by several signs. Chief among them is the fact that the contents of the swelling are partly or completely reducible by pressure, and as this reduction takes place the increased intra-cranial pressure gives rise to symptoms, varying from headache to severe signs of cerebral compression.

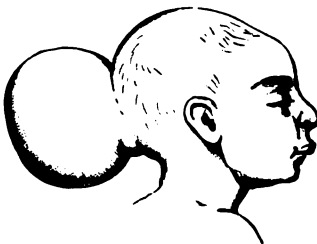


Fig. 586.—Hydrencephalocoele.

Movements of the tumour synchronous with respiration are less reliable, but by expiratory efforts, such as crying, coughing, etc., the

tumour increases in size, and a definite impulse may be felt. Pulsation synchronous with that in the arteries is frequently present in encephalocoele, less frequently in hydrencephalocoele, and rarely in meningocele.

Diagnosis. (1) *From other tumours.*—As a rule, by careful examination, the nature of the tumour is readily determined; its reducibility, the increase in size on coughing or crying, and the existence of a deficiency in the cranial wall will serve to distinguish it from cephalhæmatoma, dermoid cyst, subcutaneous nævus, etc. Sometimes the diagnosis from a dermoid cyst in the region of the anterior fontanelle is almost impossible.

(2) *The diagnosis of the varieties of cephalocoele.*—By attention to the following points some assistance may be gained in determining with which variety we have to deal. *Absolute translucency* is in favour of meningocele. In some cases there is a considerable amount of fluid in the sac of an encephalocoele, and this may give rise to translucency at some part of the tumour, but not throughout, as in meningocele. If *reducibility* is complete, the tumour is certainly a meningocele. If *pulsation* synchronous with the arteries is well marked, it is an encephalocoele. If its *size* is very great, it is almost certainly a hydrencephalocoele.

Prognosis.—In all probability spontaneous cure never takes place. Cases of meningocele have been described which have become shut off from the cranial cavity, but these are probably congenital cysts. Although a cephalocele is not incompatible with life, yet sooner or later the occurrence of inflammation in the skin over it, leading to meningo-encephalitis, or the opening up of the sub-arachnoid or intra-ventricular space, with subsequent loss of cerebro-spinal fluid, leads to a fatal termination.

Treatment.—In the majority of cases nothing can be done to relieve the malformation. Many methods have been tried, with frequent failures and few successes. In all of them a certain line of treatment is necessary, in order to prevent the onset of inflammatory trouble. In a few cases radical cure by operation may be attempted.

(a) *Palliative treatment.*—The skin over the tumour must be kept scrupulously clean, and must be protected from injury by a suitable apparatus. If any signs of inflammation in the skin should appear, every endeavour must be made by aseptic or antiseptic treatment to prevent extension of this inflammation.

(b) *Radical cure.*—With strict antiseptic precautions it is possible in some cases to cure the condition. Thus, in the case of a simple meningocele with a pedicle, it is easy to expose the tumour and ligature the pedicle. In those without a pedicle an incision should be made into the cyst, and an endeavour made to close the defect in the skull by flaps cut from the cyst wall. It might be possible to close the hole in the skull by fixing across it a piece of bone partially detached from the surrounding bone.

In the case of encephalocele and hydrancephalocele, operation is not advisable. The injection of Morton's and other fluids into the sac would only be justifiable in meningoceles, and is probably less successful and more dangerous than operative interference.

THE SURGICAL TREATMENT OF EPILEPSY.

For the proper understanding of the varieties of epilepsy we are indebted to Hughlings Jackson, who divided them into two distinct classes.

Varieties.—(1) Cases where the fit begins quite suddenly, with little if any premonition, and usually accompanied by a peculiar and characteristic cry. The patient becomes unconscious and falls down, the whole body being more or less in a state of convulsion, which may last for some minutes, and on the cessation of these symptoms the patient usually remains unconscious, frequently falling into a deep slumber. It is by far the more common variety, and is known as ordinary or **idiopathic epilepsy**. Concerning its origin and its cause nothing is known, and there is no benefit to be derived from surgical interference.

(2) Cases where previous to a fit there is a definite sensation in some particular region of the body. This is followed by a

convulsion, which begins locally in the region where the sensation was felt, and spreads to other muscles of the body in a definite order. During the fit consciousness may or may not be lost. This is usually termed **Jacksonian epilepsy**, and was shown by its discoverer to be caused by some definite pathological condition in the sensori-motor area of the cortex cerebri.

The muscles, whose cortical representation is in that part of the brain most irritated by the pathological condition, are the first to be convulsed, and, according to the degree of irritation, the resulting convulsion may be localised, or may spread to other muscles.

Thus, by watching the fit carefully, and by ascertaining the situation of the warning sensation or aura, we may be able, with great certainty, to localise the position of the lesion.

Lesions in the cortical representation of the organs of special sense may, by irritation, give rise to hallucinations of sight, hearing, smell, and taste, followed by a temporary exhaustion of these senses. This **sensory epilepsy**, as it has been called, may lead us to localise the lesion, but not with such accuracy as in Jacksonian epilepsy. Thus lesions in the temporal convolutions may cause sensory epilepsy, beginning with some sound; in the occipital lobe the epilepsy may commence with some hallucination of sight, and in the tip of the temporo-sphenoidal lobe the sensory epileptic attack may be preceded by some hallucination of smell or taste.

The majority of these cases of Jacksonian and sensory epilepsy follow injuries of the head, and some definite lesion produced by the injury can often be found. These cases form a group of Jacksonian epilepsy known as **traumatic epilepsy**. The pathological conditions that have been observed in these cases are either in the skull, dura mater, arachnoid, pia mater, or the brain; it is very doubtful whether lesions of the scalp and pericranium alone can, in any way, either by direct irritation or reflexly, cause epilepsy.

As regards the *skull*, the usual lesion is a depressed fracture, especially some splinter of bone from the inner table penetrating the dura mater.

A thickening of the *dura mater* is very common, with more or less adhesion of that membrane to the skull, and to the underlying pia mater and arachnoid.

The *pia mater* and *arachnoid* may be much thicker than normal in the region of the injury, and firmly adherent to the underlying cortex cerebri.

In the *cerebral cortex* we may find indurated patches and alterations in colour, due to extravasated blood. Cases of Jacksonian epilepsy without previous injury are usually due to tumours of the brain and its meninges, or of the skull.

Diagnosis.—Having established that the case is one of Jacksonian epilepsy, the next thing is to localise the lesion. This can only be done by an exact knowledge of the localisation of function in the brain. (See page 93.)

A difficulty may present itself in that there may be definite

evidence of an injury—*e.g.* a marked depression in the skull—and yet the fit may start in a portion of the brain at some distance from the depression. In such cases are we to accept the medical or the surgical indication? From numerous cases that have been reported it seems that the medical indication is more likely to be correct, and, therefore, that part of the brain associated with the muscles commencing the convulsion should be first exposed, and, if no lesion be found, the site of the depressed fracture should be trephined.

We sometimes find that, following an injury, attacks of epilepsy of the ordinary or idiopathic type may develop, and there may be no indication of the seat of the lesion. In such cases it is right to trephine if there are any definite signs of injury, especially if there be evidence of depressed fracture.

Treatment.—It is obvious that, if the epilepsy is due to a definite local condition, it might be cured by removing the exciting cause.

Many cases of Jacksonian epilepsy have now been operated upon, and it is found in the large majority of cases that although the attacks of epilepsy may cease for some time after the operation, yet the fits recur after an interval of longer or shorter duration.

In these cases it is probable, either that the whole of the original mischief has not been removed, or that the scar resulting from the ablation of the primary lesion acts as an irritant, and starts the epilepsy again. On the other hand, there are cases which have been permanently cured by the removal of the exciting lesion. We may sum up the question of operative interference in Jacksonian and traumatic epilepsy in the following way: in many cases the pathological condition causing the epilepsy is removable, but this fact can only be ascertained by an exploratory operation—such an operation is at the present day quite devoid of any special danger; if a distinct lesion can be found, it should be removed if possible, in the hope that the epilepsy may be cured or, at any rate, improved. It is important that the patient or his friends should be told before the operation is decided upon that the chances of permanent cure are slight, that the probability of temporary relief and improvement is considerable, and that the exploratory operation, at any rate, is devoid of special danger.

In some cases, although the epilepsy may commence in a localised group of muscles, and be preceded by a definite aura in that region, yet nothing abnormal can be found on exposing the cortical representation of those muscles. In these cases Horsley recommends that, by means of a Faradic current, the exact sensori-motor area should be determined, and the area of cortex removed.

The objection to this method is that a scar develops on healing, which may lead to a recurrence of the Jacksonian epilepsy after a time; in fact, a definite lesion is substituted for a hypothetical one.

The operation consists in removing a large piece of bone from over the suspected area, in opening the dura mater, and examining the convolutions. If a definite pathological condition is found it should be removed.

THE SURGICAL TREATMENT OF MICROCEPHALIC IDIOTS.

The idea that premature ossification of the cranial sutures can be primarily the cause of microcephalic idiocy is supported by no definite evidence. The reason that the sutures do not ossify during normal childhood is because the brain is rapidly growing, and by its progressive increase in size tends to separate the cranial bones. As soon as this enlargement of the brain ceases, ossification gradually takes place. If from any cause the brain should not develop at a rate sufficient to prevent the union of the sutures, there is a tendency for the sutures to ossify. This premature ossification, however, is secondary to the arrested development of the brain, and is not in itself the cause of the microcephalic idiocy. Of recent years Lannelongue has introduced a new treatment for microcephalic children who are deficient in intellect. This consists in removing strips of bone from the skull so as to diminish any resistance that it might offer to the expansion of the brain. To this operation the term *craniectomy* is sometimes applied, but inasmuch as the principle of the operation is to make an artificial suture rather than to remove bone, the term *craniotomy* is perhaps a better one. The cases reported by Lannelongue were apparently much improved by the operation, and since the publication of his paper, numerous cases have been recorded, but with less encouraging results.

It must be remembered that the causes of this idiotic condition are various, and that although in some cases craniotomy may be advisable, yet in others it is quite useless. It is important to distinguish two important groups of cases:—

Varieties.—(1) **Congenital**, in which from birth there is evidence of cerebral defect which is due to some error in the development of the brain. Cunningham demonstrated this fact in a striking manner before the Anatomical Society of Great Britain and Ireland. He pointed out how the brains of microcephalic idiots approached in many characters the type of brain met with in apes, and in a few respects even with that met with in quadrupeds. Cases of microcephalus, in which, after post-mortem examination, it has been stated that the brain was normal, would probably be found, on careful observation, to belong to this group.

(2) **Pathological**, in which some injury or disease of the brain, either during intra-uterine life or in early infancy, has arrested the development of the brain and impaired its functions.

These cases are classified by Allen Starr in three groups as follows:—

(a) *Infantile cerebral hemiplegia*.—The paralysis is present at birth, and is either developed in utero or caused by some injury received during parturition.

(b) *Mental defects*.—These cases present various kinds of mental defects, but no marked abnormal physical signs.

(c) *Sensory defects*.—These present no abnormal motor or mental signs, but have various defects of sensory perception, such as deaf-mutism, hemi-anopsia, etc.

In all these pathological cases there is more or less atrophy with sclerosis of the brain. In addition there may be *porencephalus*, i.e. a localised atrophy or even absence of development leading to the formation of a cavity in one of the cerebral hemispheres which may communicate with the corresponding lateral ventricle; *meningo-encephalitis*; *hæmorrhage* or *cysts*, in or upon the surface of the brain; *hydrocephalus*.

In many of these conditions it is obvious that craniotomy, or, indeed, surgical interference of any kind, could be of no avail. In other cases, however, it is possible that the arrest of development of the brain may be quite temporary, and that if the sutures had not ossified the brain might continue its normal development on the cessation of the disease. In such cases the operation of craniotomy, by allowing expansion of the skull, might be very beneficial. In some cases, after the bone has been trephined and the dura mater incised, it is obvious from the bulging of the brain that the intra-cranial tension is increased, and in these instances the operation leads to more or less improvement. There seems no doubt that in a few instances considerable improvement has taken place in cases where there was no increased intra-cranial tension; and the suggestion has been made that the operation stimulates the growth of the brain in some obscure manner.

The operation of craniotomy.—The strip of bone is usually taken in a longitudinal direction parallel with the sagittal suture and about half an inch from it. A suitable skin flap is turned down, and a trephine half or three-quarters of an inch in diameter is used to remove a disc of bone. By means of sharp-cutting gouge forceps the bone can be quickly cut away in any direction and to any extent.

By many it is recommended that the dura mater should not be incised. It is impossible to determine, however, the nature of the pathological lesion that is present, if any, unless an exploratory incision is made into the dura mater.

Many deaths have taken place after craniotomy in microcephalic idiots, and they seem to have been due, in most cases, to shock. This can be prevented, however, by removing small pieces of bone at several operations, instead of a long strip at one operation. In this way the operation is rendered devoid of any special risk. By four or five operations a strip of bone half an inch wide and six or seven inches long can be removed from the skull on each side of the sagittal suture. It must be borne in mind that the after-treatment of the case is most important. Every endeavour should be made to instruct the child and to cultivate its intellect in a systematic manner.

In considering the beneficial effect of the operation, it is most important to remember that the improvement in many cases may

have been due to the systematic training of the child carried out after the operation, and that the surgical procedure in itself may have had but little to do with the result.

So far as our experience guides us at present, we may formulate the following **conclusions** :—

(1) That the operation of craniotomy, if performed in four or five stages, is devoid of any special risk.

(2) That in the *congenital* cases, where there is probably always a mal-development of the brain, the operation is of no avail.

(3) That in certain *pathological* cases the operation may be of some use in improving the child's condition ; such as

(a) Cases in which blood-clots or cysts are present in or upon the surface of one cerebral hemisphere, as in some cases of infantile cerebral hemiplegia.

(b) Cases in which it is found on trephining that there is increased intra-cranial tension.

(c) Cases in which epileptic fits form a prominent feature are generally much improved or the fits considerably modified by the operation.

(d) Cases in which, during a temporary arrest of the development of the brain, the cranial sutures have prematurely ossified.

(4) That in certain *pathological* cases the operation is of no avail, such as

(a) Marked atrophy and sclerosis of the brain.

(b) Conditions of *porencephalus* and *hydrocephalus*.

(5) It is impossible to determine the exact pathological lesion unless an exploratory operation is performed, with opening of the *dura mater*.

(6) That in many cases by systematic training the mental condition can often be much improved without operation.

XXXVIII. INJURIES OF THE SPINE.

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Contusions of the spine.—Contusions of the spine and soft parts about it present no peculiarity beyond their relation to possible injury of the spinal cord.

Large subcutaneous or subfascial hæmatomata in the dorsal and lumbar regions are common, and in some cases may persist for years (the writer has recently seen a case of sixteen years' duration), when they sometimes present the appearances of large multilocular tumours with well-defined hard margins, the result of the organisation of fibrinous deposit like that often seen in hæmatoma of the scalp.

Heavy blows—*e.g.* from spent shot or cumbrous masses of material—may cause sloughing of the integuments, especially about the lumbo-sacral regions, where large open wounds exposing the bones beneath may thus result. In extreme cases of this kind necrosis may follow, and the spinal canal be opened up.

Slight contusions, the result of apparently trivial injuries, may be followed immediately, or in the course of a few hours or days, by symptoms of various degrees of spinal cord damage, and symptoms of complete destruction of the cord at the seat of lesion may follow directly upon apparently unimportant contusions without perceptible injury to the bones. In certain cases of severe contusion which have terminated fatally, the spinal cord has been found upon post-mortem examination completely disorganised opposite the seat of injury as early as three days after the accident, no gross lesion to the bones or ligaments being perceptible.

The *prognosis* in contusions of the spine depends entirely upon the implication, or not, of the spinal cord; when the cord is uninjured, the cases follow the ordinary course of bruises in other parts. Uncomfortable stiffness and muscular pains from matting together of the soft parts may persist for considerable periods, especially if complete rest be maintained for an unnecessary length of time. All cases of contusion of the back, however slight, in which modification of sensation follows—*e.g.* numbness, tingling or

formication, or in which the action of the bladder is in any way interfered with—should be regarded as serious, as such symptoms may be held to be certain evidence of implication of the spinal cord, and should be treated accordingly.

The *treatment* of contusions must be conducted upon ordinary principles with such special precautions as will be indicated under the treatment of sprains.

Sprains, twists, and wrenches of the spine.—The complicated mechanism of the spinal column with its multiplicity of joints and numerous ligaments, some elastic and others inextensible, renders it peculiarly liable, for obvious mechanical reasons, to indirect injuries which may cause immediate or remote symptoms of a serious or trivial nature.

The *causes* of sprains and kindred conditions are indirect injuries, such as falls from a height on to the head or buttocks, acute flexion, or over-extension of the spine, as may occur in a variety of accidents.

Pathological anatomy.—The lesion may consist of a slight or extensive laceration of the vertebral aponeurosis, muscles or other soft parts only, the column itself being uninjured. The spinal ligaments may be merely over-stretched, or may be lacerated partly or completely. The inter-vertebral disc may be more or less torn away from one of its adjacent vertebral bodies (usually the upper). In severe cases the anterior or posterior common ligament may be ruptured; in the latter case laceration of the veins lying between the ligament and vertebral bodies may cause bleeding into the canal with all the resulting symptoms of pressure on the cord from hæmorrhage between the bones and dura mater. Rupture of the ligamenta subflava may also lead to bleeding into the canal. Spinal meningitis may occur with or without antecedent hæmorrhage. Hæmaturia, in consequence of bruising or laceration of the kidney, and traumatic hydronephrosis may follow. The ureter has been completely torn across in violent sprain of the back.

The **symptoms** in a general sense are similar to those produced by sprains elsewhere;—pain, especially on movement, stiffness, tenderness, local swelling from blood effusion, and discoloration from bruising which, when the lesion is deep, may be a long time in showing itself, and may appear at a considerable distance from the seat of injury, in consequence of the arrangement of the fascial plains.

Tenderness, when over the middle line, always involves several or many spinous processes, and never only one, as is commonly the case in fracture. No irregularity of the spinous processes exists, and the other signs of fracture are absent.

In sprains of the dorsal region especially, in addition to the other symptoms, a feeling of peculiar weakness of the back is always present. In cases of sprains and contusions the patients almost invariably lie on one or the other side with the lower limbs flexed, so that the knees almost touch the trunk.

Acute pain, which rapidly subsides or may be long persistent, sometimes follows along the nerves coming from the injured spot.

Prognosis.—In contusions and sprains of the spine, the existence or non-existence of spinal cord implication mainly determines the prognosis of the case. In the absence of signs of injury to the cord the immediate prospect is good, although in some cases in which sloughing of the soft parts results, the patient may run some risk from septic infection or exhaustion during the separation of the sloughs. When the cord is implicated, the prognosis must be determined in the manner indicated in the sections on traumatic lesions of the cord and fracture-dislocation.

The *remote effects* of sprains and contusions are for the most part inseparably connected with those of concussion of the spine (so-called), with which they will be discussed (page 254). The remote effects unconnected with cord lesions are weakness of the back from wasting of muscles, from disuse; stiffness, from adhesion and matting together of the soft parts generally; abscess from breaking down of hæmatomata; inflammation of inter-vertebral synovial joints resulting in suppuration or pulpy disease, especially from the neglect of cases apparently trivial at first; caries, ulceration of inter-vertebral discs, and possibly malignant disease of the column.

Long persistent neuralgia from chronic inflammation of the nerves passing from the seat of lesion (especially in the cervical region in the form of obstinate occipital pain) is a fruitful source of trouble. When occurring some time after injury to the lower dorsal region, nerve pains of this kind may be mistaken for dyspepsia.

The **treatment** of sprains and contusions of the spine unassociated with symptoms of cord lesion should be conducted upon the ordinary principles usually applied to similar injuries in other parts. When complicated with evidence of injury to the cord, the treatment must be, of course, chiefly directed to the graver condition. Complete rest is the essential primary treatment. Rapidly increasing blood effusion in the soft parts should be treated by application of cold, and subsequently, when the increase has ceased, by warm applications. Careful attention must be given to the state of the bladder, and the urine should be examined for blood, as evidence of possible renal damage. Complete rest should be insisted upon until all tenderness over the spinous processes has disappeared, and, of course, till the subsidence of signs of spinal cord lesion, if they have been present. When no signs of damage to the cord exist, a well-fitting felt or leather jacket may in adults be applied as soon as the acute symptoms have subsided.

The persistent pain about the back over the region of the erector spinæ, which often follows in sprains, can generally be cured (after minor measures have failed) by forcible flexion of the spine under an anæsthetic, by means of which the adhesions about the muscles and soft parts are broken down. This forcible movement is best effected in the following way:—The patient having been placed on a flat couch, the surgeon flexes the lower limbs until the knees are in

contact with the trunk, a proceeding which sometimes requires much force, in consequence of the general stiffness and matting together of the soft parts about the buttocks; secondly, the lower limbs being still kept in this flexed position, he stands behind the patient's head, leans forwards, and grasping the flexed knees, draws them towards him until the buttocks and lower part of the trunk are raised to a line almost vertical to the couch. This proceeding should be repeated several times in succession. By the same means may often be cured the constant aching and neuralgic pains which sometimes persist after sprains, and which, although frequently attributed to the results of concussion of the spine, are really only due to the matting together of the tissues in which the nerves lie as they pass from the canal. This forcible flexion (or "bone-setting") should be followed by massage and methodical muscle exercise, *not by rest*. It is obvious that this treatment must only be practised after all acute symptoms have subsided, and when no evidence of cord lesion exists.

Obstinate pain over the middle line of the spine without stiffness or muscle waste may be effectually treated by the thermocautery or flying blisters. Pain occurring, as is often the case, in hysterical subjects must be treated on the usual well-recognised principles. After-effects in subjects obviously rheumatic or gouty must be managed with a view to the constitutional diathesis. The treatment of gross remote effects—such as caries, abscess, malignant disease, etc.—is described under their respective headings.

FRACTURES AND DISLOCATIONS OF THE SPINE:

FRACTURES.

Varieties.—These injuries, which are commoner amongst males than females, may be conveniently divided into three distinct classes—pure fracture, pure dislocation, and fracture-dislocation, *i.e.* fracture combined with dislocation.

Setting aside cases of partial fracture—such as fissures of the vertebral bodies, and fractures of the spinous or transverse processes—fracture-dislocation is by far the commonest of the three classes, and represents about 70 per cent. of the total number of cases, the remaining 30 per cent. being nearly equally divided between pure fracture and pure dislocation.

In the cervical spine pure dislocation is more common than fracture, whilst in the dorsal and lumbar regions pure fracture is more frequent than dislocation. Complete fracture without dislocation is very rare indeed in the cervical region.

Fracture may be incomplete or complete.

Incomplete fracture.—In this fracture the continuity of the column is not interrupted.

(a) **Fracture of the spinous processes.**—This is commonest in the lower cervical or dorsal regions. It may be the result of direct or indirect injury, usually the latter. Its symptoms are

pain on movement, local tenderness, irregularity in the line of the processes, mobility, crepitus, and often swelling from blood extravasation.

(b) **Fracture of the laminae.**—This is more common than is usually supposed, and when both laminae are fractured direct violence is usually the cause. Fracture of one lamina is not very uncommon about the lower cervical and upper dorsal region, from injury caused by subjects falling whilst carrying heavy weights on the shoulders—such as *e.g.* a sack of coals. In fracture of both laminae the spinous process, with the mesial parts of the broken laminae, may be driven inwards, and cause pressure on the cord. In fracture of both laminae the *diagnosis* is easy, on account of the mobility of the whole spinous process with crepitus and pain; in some cases in which the detached fragment is driven forwards into the spinal canal causing symptoms of pressure on the cord, a well-marked depression over the line of the spinous processes indicates the nature of the lesion. In fracture of one lamina the diagnosis is more difficult. In the normal state the spinous process is perfectly rigid and unyielding, no matter how much it may be subjected to pressure. In fracture of one lamina, it will be found that, in addition to tenderness, the spinous process springs a little on pressure, in consequence of the interruption in the continuity of one side of the vertebral arch, a peculiar shooting pain passing at the same time from the middle line toward the injured side. Crepitus can rarely be felt.

(c) **Fracture of the transverse processes** is rare, excepting as the result of gunshot or other wounds.

(d) **Fissures of the vertebral bodies** (latent fracture so-called) are rare, but occasionally occur in the upper dorsal or extreme lower cervical regions, as the result of violent sprains or wrenches. These injuries cannot be diagnosed with certainty, but there is good reason for supposing that a fair proportion of cases of so-called sprains and contusions, associated with transient symptoms of cord lesions (from hæmorrhage into the canal, etc.), are cases of incomplete fracture of the vertebral bodies.

(e) **Partial separation of the inter-vertebral disc** from the body of one of its adjacent vertebrae.—Although not a fracture in the limited sense in which the word is generally used, this injury is, for clinical purposes, conveniently mentioned here. It is a lesion of considerable importance in relation to the occurrence of caries as a remote effect of injury to the spine in young subjects. Its causes are the same as those of sprains and twists, from which it is indistinguishable, as the symptoms are identical, whether occurring with or without evidence of spinal cord implication.

The **treatment of incomplete fracture** is in the main the same as that of sprains and contusions.

Fractures of the spinous processes do not always unite by bony union, in which case permanent mobility of the affected process a result; occasionally the severed process necroses, and may be discharged from an abscess—a fractured transverse process may be

thrown off in the same way. The more serious remote effects of partial fractures, such as caries and secondary cord changes, as well as immediate damage to the cord, are dealt with elsewhere.

Complete fracture.—By this is understood solution of continuity of the bony column, resulting in its separation into two distinct portions, with or without displacement of the separate parts from one another. This injury may occur with or without dislocation of the inter-vertebral articulations; in the majority of cases it is clear from the anatomical arrangements of the parts that

extensive displacement is almost impossible without dislocation of one or more of these joints; hence fracture with dislocation (fracture-dislocation) is the commonest form of the lesion met with.

Pathological anatomy.—

The amount of damage to the *bones and soft parts* varies greatly in different cases. As a rule, the lesions produced by indirect injury exceed in extent those caused by direct violence, injuries due to projectiles being excepted. Generally the vertebral body is irregularly broken and crushed; hence the fracture is usually comminuted, and loose bony fragments may be driven inwards, impinging upon or lacerating the cord (Fig. 588). The fracture may be impacted, the broken parts being crushed together, so as to form a compact solid mass. The spinous and transverse processes and the laminae may be extensively broken, or only slightly involved, or may



Fig. 587.—Horizontal Laceration of Inter-vertebral Disc between the first and second Lumbar Vertebrae. (St. George's Hospital Museum.)

even escape fracture altogether. The upper segment of the fractured column is usually displaced forwards from the lower, the displacement varying from a slight forward projection, or bend, to complete disconnection (Fig. 589). The inter- and supra-spinous ligaments are generally ruptured, and the ligamenta subflava partly or entirely torn across. The anterior and posterior common ligaments may one or both be partly or completely lacerated, the anterior being the most injured as a rule. In some cases the main lesion consists of laceration of the inter-vertebral disc, which is torn away from one of its adjacent vertebral bodies, usually carrying a few small pieces of bone with it (Fig. 587). In rare cases the disc may be separated into two layers by complete horizontal laceration. In some of these lacerations of the disc, the only other gross lesion is rupture of the anterior common ligament; no displacement may

then take place at all, or the spine may merely bend backwards, without any other bony displacement.

The soft parts around the fracture are bruised, lacerated, and swollen from blood extravasation.

The *spinal membranes*, as a rule, escape laceration, but may be torn by spike-like pieces of bone in much comminuted fractures. As a result of rupture of the veins in laceration of the posterior common ligament and ligamenta subflava, extravasation between the bones and the dura mater is common; bleeding may also occur between the dura mater and the cord.

Speaking generally, *lesions of the spinal cord* are greater in fracture of the cervical and upper dorsal than of the lower dorsal and lumbar regions, and the degree of injury to the cord depends to a great extent upon the amount of displacement of the bones; nevertheless, complete disorganisation of the cord at the seat of fracture may occur when the displacement is very slight, sometimes when there is no displacement at all, and occasionally even when there is no perceptible damage to the membranes. The cord lesion varies from slight compression or bruising to complete division (Fig. 588). Cord lesions without displacement of the bones usually depend upon concussion, hæmorrhage between the bones and dura mater, or upon acute or chronic myelitis following upon the injuries to the ligaments or membranes. Symptoms of complete transverse lesion of the cord may occur from severe concussion in cases of fracture without displacement and without hæmorrhage into the canal; in such cases the cord has been found upon *post-mortem* examination completely disorganised at the seat of injury as early as three days after the accident, no signs of gross lesions to the bones or ligaments being present.

The **causes of fracture** are violent injuries direct or indirect. The former may be illustrated by the injury a patient receives in falling across a beam, or from the direct impact upon the spine of any heavy body; and the latter by the injury produced by over-flexion of the spinal column, as may occur in falling from a height on to the shoulders or buttocks.

General symptoms of fracture-dislocation.—The initial symptom is collapse, amounting in some cases to complete unconsciousness; upon the recovery of consciousness the characteristic symptoms of the lesion become manifest.

Symptoms of the damage to the bones.—Pain over the affected part greatly increased by movement; tenderness and swelling from blood extravasation; crepitus, except in cases of impaction; deformity, in various degrees in different cases, may be present.

Symptoms of spinal cord lesion.—In ordinary cases there is immediate *paralysis* of all parts below the seat of fracture either from compression, laceration, or concussion of the spinal marrow; there is loss of power over the sphincters, and all conducting power in the cord ceases at the level of the injury; in some cases, however, where the displacement is not great, the loss of

power may not occur until several days after the accident ; again, the palsy may be partial when due to injury of the cord by sharp pieces of bone in comminuted fracture, or when the displacement is slight, and sometimes when the cause of the paralysis is blood effusion between the bone and dura mater. Loss of power is not always associated with *loss of sensation*, but loss of sensation without palsy is practically never seen. The anæsthesia, however, does not always involve the whole of the palsied area ; sometimes its upper limit is considerably lower than that of the palsy, and it may be patchy in its distribution, spots of comparatively perfect sensation existing in the midst of large areas of general anæsthesia ; this is especially the case when the symptoms are wholly or in part due to hæmorrhage outside or inside the dura mater or in the cord itself. A line of extreme hyperæsthesia often separates the palsied from the natural parts.

The *temperature* in the parts below the lesion is, as a rule, high directly after the injury, and in severe crushing of the cervical cord may reach a great height (110° to 112° , or even 115° Fahrenheit); the superficial arteries being at the same time full and throbbing. In contra-distinction to this hyperpyrexia, which is transitory only, in some cases the temperature is curiously low, sinking to 95° or even less (in a case of the writer's the temperature was barely 94°). In some cases gradual falling of the general temperature from the normal immediately after the accident to 80° just before death has been noted ; in other cases a steady rise of temperature may continue till death, and may still increase for some time subsequently.

The *pulse*, as a rule, follows the temperature, rising as it rises, and gradually slowing down as the temperature falls, sometimes reaching as low a rate as twenty-five beats to the minute before death.

Reflex action is at first entirely wanting (from shock) in all parts below the seat of injury ; soon it becomes exaggerated unless the lumbar enlargement of the cord is involved in the damage, in which case reflex action does not return. Having returned, it may again be lost from downward extension of secondary changes in the cord.

Symptoms involving the urinary organs.—Complete retention of urine follows immediately upon the injury in consequence of paralysis of the reflex centres from shock, but is temporary only. When the lesion is above the lumbar region, retention is succeeded at intervals by involuntary discharges (reflex) of urine of which the patient is unconscious. In some cases there may be an ill-defined feeling on the part of the patient that the bladder is about to act, but there is entire inability voluntarily to restrain or hasten the evacuation, although in some long-standing cases intelligent patients may assist in emptying the bladder by pressing on the abdominal walls upon perceiving the onset of the bladder action. In damage to the lumbar enlargement or the cord below, whether as the immediate result of the accident or from subsequent changes, the urine

continually runs away from palsy of the sphincter, and by degrees the bladder decreases in size, becoming at the same time thickened, so that no material accumulation in the viscus takes place over and above that which is entailed by the position of the patient. At first the urine is normal, excepting when it contains blood, the result of coincident bruising or laceration of the kidney by the injury. Soon it becomes turbid and ammoniacal, depositing a thick, tenacious mucus mixed with phosphate and carbonate of lime, the result of cystitis and urinary decomposition, which may occur under certain circumstances in any case of retention.

Sooner or later, sometimes within forty-eight hours, and sometimes not until months after the injury, a change in the urinary conditions occurs in consequence of the direct effect of the nerve lesion upon the nutrition of the bladder and kidneys. Blood and pus appear in the urine, the result of ulceration of the bladder and suppuration or disorganisation in the kidneys; at the same time, or a little later, the tissues around the urethra may slough, leading to the formation of urinary abscess and infiltration into the perinæum in consequence of the breaking down of the walls of the urethra. These changes are generally accompanied by the formation of rapid bed-sore, and, as a rule, are indicative of approaching death. The conditions of the bladder and kidneys have nothing essentially to do with backward pressure from obstructed flow of urine, or faulty catheterisation, but are the direct effect of the modification of nervous influence resulting from the primary damage or secondary changes in the cord. Stricture of the urethra may, however complicate such conditions, as in a case seen by the writer, in which the passage of a soft catheter through a stricture could only be effected by the use of an amount of force which led to its entering the rectum when the perineal tissues were breaking down, in the manner indicated, from the effect of the nervous lesion.

Paraplegia from interruption of the conducting power by the damage to the cord, resulting in loss of the control normally exercised by the cerebral centres, is a prominent and common symptom in fracture-dislocation as evidence of implication of the sexual apparatus. It usually appears immediately after the initial shock



Fig. 588.—Comminuted Fracture of the Body of the Sixth Dorsal Vertebra with Displacement, showing mode of Pressure upon the Spinal Cord. The patient lived for 44 days after the accident. (St. George's Hospital Museum.)

has passed away, and is common in injury of the cervical and upper dorsal regions; it is very rare in damage to the lower dorsal spine, and, excepting in a few anomalous cases, is never seen when the injury involves the lumbar enlargement, or the parts below it. Sometimes priapism does not appear at once, but follows after an interval; it is then caused by hæmorrhage or some other source of irritation to the reflex centres. In any case it is not necessarily persistent, and frequently disappears in consequence of the lumbar enlargement becoming involved in descending secondary changes from hæmorrhage or myelitis. The condition of the penis is nearly always one of passive engorgement; the organ is full but not erect. In some cases erection, occasionally painful, occurs, especially when the cord is irritated by spikes of bone. In a few cases the passively engorged organ becomes erect during the passage of a catheter, and rarely in the same way a seminal discharge may be excited, the patient having no consciousness of the emission.

The *condition of the rectum* is analogous to that of the bladder; the sphincter power is lost. Excepting when diarrhœa is present, the motions do not, however, constantly run away as the urine does from the bladder, but pass at intervals without the knowledge of the patient, as a rule, although sometimes there is a vague consciousness that the discharge is taking place. This difference between the behaviour of the rectum as compared with the bladder is principally due (1) to the difference in the consistence of the contents, and (2) to the intermittent manner in which *fæces* enter the rectum in contra-distinction to the almost continuous flow of urine into the bladder through the two ureters.

Other symptoms of *interference with the alimentary tract* are met with in the frequent vomiting common after injury of the cervical cord, the less common hiccough, and the occasional dysphagia, this last being as often as not due merely to the bony displacement. Tympanites from distension of intestines and stomach is also nearly inseparable from severe dorsal injury, in consequence of the loss of support which follows the palsy of the abdominal muscles.

Fracture-dislocation in the cervico-dorsal region causes serious *respiratory troubles* by paralysing the intercostal muscles, and similar damage in the lower dorsal region embarrasses the breathing by giving rise to the general intestinal distension caused in the manner just indicated. The paralysis of the abdominal walls throws further stress upon the embarrassed lung, by removing the power of coughing, so that the rapidly-accumulating mucus cannot be thrown off.

A very constant and disturbing symptom in fracture-dislocation is "*acute*" *bed-sore*, so-called from the rapidity with which it is liable to come on within three or four days of the injury before simple pressure, or irritation from soiling of the parts by urine or *fæces*, could be regarded as sufficient reason for its production. The actual cause is the direct effect produced upon the nutrition of the

part by the cord lesion, which in the same way leads to the bladder ulceration, kidney disorganisation, and peri-urethral sloughing already described, with which the onset of acute bed-sore commonly coincides. The sore usually occurs first in the sacral or lower lumbar region as a dusky bluish swelling, the surface of which soon vesicates; ragged sloughs rapidly form, and an irregular inert wound, surrounded by a low form of cellulitis, follows, often exposing the subjacent bones, necrosis of which is prone to happen; if the patient survives long enough, the spinal canal may be opened up in rare cases. These sores are not confined to the back, but may affect the scrotum; are sometimes symmetrical over the anterior superior iliac spines, and may form over any bony prominence in the palsied limbs. Acute bed-sore is not necessarily limited in its onset to the first few days after the original injury, but may occur at any time in the course of a case of fracture-dislocation if rapid changes in the cord occur, *e.g.* if in damage of the dorsal cord rapid descending changes involve the lumbar enlargement. The ordinary bed-sore, which is liable to occur over points subjected long to pressure in any case of exhausting disease, although it may occur in the course of a case of fracture-dislocation, has nothing in common with the acute bed-sore now described, but it may assume the characteristics of acute bed-sore at any time if rapid descending changes occur in the cord.

Symptoms peculiar to fracture of the column in different regions.—The principal of these have been mentioned in the foregoing general description of the symptoms of fracture-dislocation.

Fracture-dislocation of the first, second, or third cervical vertebra, including fracture of the odontoid, and rupture of the transverse ligament. This is generally an immediately fatal injury, but death may be postponed for some hours if the displacement is slight, in which case the symptoms are general palsy of all parts below the head, with rapidly increasing asphyxiation. If the symptoms are due to hæmorrhage and not to crushing of the cord by bony displacement, the paralysis need not be at first complete or symmetrical. Traumatic myelitis, with or without spinal meningitis, if survival is long enough, occurs invariably.

Fracture-dislocation of the cervico-dorsal region, or, in other words, the portion of the spine (from the third cervical to the second dorsal vertebra) corresponding to the cervical enlargement of the cord (Fig. 589). Complete destruction of the cord at the seat of injury is the rule. There are palsy and anæsthesia up to the level of the cord lesion. The upper extremity is palsied, partially or completely, if the injury is above the second dorsal vertebra—the fore-arm being involved before the arm. As a rule, the biceps is the last muscle to lose its power. If the lesion is in the cervical region vomiting is common, and persistent hiccough sometimes sets in. From implication of the sympathetic, dilatation of the pupils may be impossible, so that vision is sometimes affected. Sensation, although entirely wanting in the

upper extremity, may still be present about the root of the neck and in front of the thorax as far down as an inch or even two inches below the nipples, owing to the distribution of the descending branches of the cervical plexus. The breathing is diaphragmatic, but if the serratus magnus muscle escapes paralysis it may render assistance in some cases. There is true fecal incontinence. The urine, after the primary retention, passes away involuntarily and continuously, not as an overflow from distension, but simply trickles away as fast as it is poured into the bladder by the

ureters. Sugar is sometimes found in the urine.

Fracture-dislocation of the dorsal region between the second and tenth dorsal vertebrae, the portion of the cord involved being that between the cervical and lumbar enlargements. Here there is paralysis of the lower extremities and abdominal walls, and also of the thorax to an extent which is determined by the level of the lesion, with corresponding loss of sensation. Tympanitis-distension is a necessary result of the palsy of the belly walls. When the damage is below the sixth dorsal vertebra, the breathing, principally diaphragmatic, is assisted by the muscles of the upper part of the thorax.



Fig. 569.—Fracture-dislocation. The Sixth Cervical Vertebra is displaced forwards. The cord was crushed; the membranes were intact. The patient lived for 4 days. (St. George's Hospital Museum.).

Coughing is impossible, hence mucus accumulates in the bronchi, the breathing being at the same time embarrassed by the tympanites. The urine dribbles away continuously; the bladder itself contracts; there is fecal incontinence, generally with some vague sense of the evacuation. Priapism may occur when the lesion is above the level of the sixth dorsal vertebra, but is rarely seen if the injury is below that level.

Fracture-dislocation of the lumbar and last two dorsal vertebrae.—When the lesion is not higher than the third lumbar, and is therefore below the spinal cord itself, involving merely the cauda equina, complete paraplegia is not necessarily present. The symptoms, therefore, may amount only to extreme weakness of the lower limbs in the erect position, free and strong movement being often possible if the patient be laid flat on the back. There may

be only partial paraplegia even if the injury be as high as the tenth dorsal vertebra; the loss of sensation may also be incomplete. A narrow line of hyperæsthesia is common at the junction of the normal and affected parts. Distension of the bladder, which naturally follows, is painful, and the introduction of a catheter causes discomfort.

When the nerve lesion is limited to the cauda equina, the emptying of the bladder by the catheter is often followed by re-appearance of normal sensation in the viscus, which may completely recover. Fæcal incontinence, always present at first, may also pass off by degrees. Priapism never occurs. In severe crushes of the cauda and lower part of lumbar enlargement, the symptoms of complete transverse lesion of the spinal cord at the level of the injury are present. The partial symptoms occurring in some cases of fracture-dislocation even as high as the tenth dorsal vertebra are probably explained by the way in which the cord is protected at that level by the numerous supple nervous cords of the cauda equina.

Prognosis of fracture-dislocation.—Fracture-dislocation of the spine must in any circumstances be regarded as an injury of the gravest nature. The great majority of cases terminate fatally, some immediately, others at periods varying from a few hours to six months or even longer from the time of the accident.

The direct causes of death are (1) complete or nearly complete laceration, compression or concussion of the cord above the level of the phrenic nerves; (2) extra- or intra-dural hæmorrhage; (3) acute ascending or descending myelitis; (4) acute spinal meningitis; (5) extra-dural suppuration leading to meningitis; (6) acute bed-sore, cystitis, bladder ulceration, and kidney disorganisation from secondary trophic disturbances. The higher the lesion the more hopeless is the prospect—cases in which the two upper cervical vertebræ are concerned being necessarily fatal; in other regions the nature of the injury and the amount of displacement are important factors in determining the result. The greater the displacement the more, as a rule, is the cord crushed; hence the results of indirect injuries are the more certainly fatal in consequence of the greater displacement caused by them.

The chances of recovery, *cæteris paribus*, decrease with the advancing age of the patient. In the later periods of life especially, the existence of bronchitis, pulmonary emphysema, and to a less extent enlarged prostate and unsound kidneys, adds materially to the gravity of the condition.

When the first three cervical vertebræ are concerned, although the prospect is practically hopeless, death is not always immediate, even when the damage to the cord is above the apparent origin of the phrenic nerves; but so rapidly does traumatic myelitis follow, that prolongation of life for more than twenty-four or at the most thirty-six hours must not be expected. Rare cases of recovery from fracture-dislocation in this region have been mentioned,

but the accuracy of the diagnosis must be at least doubtful. When the crushing of the cord is below the origin of the phrenics, if death does not ensue almost directly, the length of survival will be determined by the time which intervenes before ascending inflammatory changes involve the phrenic centres.

In the **dorsal region**, again, the prognosis is bad, mainly because the damage to the cord is usually so complete, and because of the nearly certain occurrence sooner or later of secondary cord changes with their exhausting consequences—namely, acute bed-sore,

cystitis and bladder ulceration, and kidney disorganisation. A further grave obstacle to recovery, which increases with the height of the lesion, is the palsy of the intercostal muscles which interferes with respiration—already embarrassed by the tympanitic distension of the belly from paralysis of its walls. The term of survival does not generally exceed ten days or a fortnight: it may, however, be as much as six months; eighteen months have intervened before death, and permanent recovery with paraplegia occasionally occurs (Fig. 590). The usual cause of death in delayed cases is descending myelitis, involving the lumbar enlargement, which ushers in the onset of the acute bed-sore, bladder and kidney mischief already referred to.



Fig. 590.—Bony Union after Fracture-dislocation involving the Eleventh and Twelfth Dorsal Vertebrae. The patient died 190 days after the accident from secondary changes in the cord. (St. George's Hospital Museum.)

The most hopeful cases of fracture-dislocation are those involving the **lumbar spine**, in consequence of (1) the massive strength of the bones and the way in which they are protected by the strong surrounding muscles and aponeuroses; and (2) the protection which the extreme lower end of the spinal marrow receives from the tough nervous cords forming the cauda equina. The most hopeful cases of all, for obvious reasons, are those in which the injury is below the termination of the spinal cord, i.e. below the second lumbar vertebra, and therefore involves the cauda only; in such cases complete recovery may follow with merely a little weakness of the lower extremities, and recovery with partial paraplegia is not uncommon. If the damage

involves the extreme lower end of the cord within the lumbar limit, the prospect is naturally not so good ; nevertheless, recovery without complete paraplegia may follow even when the paraplegia has been complete at first. The prospect of recovery will be entirely removed by the occurrence of ascending myelitis involving the lumbar enlargement (leading to the formation of the characteristic acute bed-sore, etc.), which almost invariably develops sooner or later if complete recovery—or, at least, very great improvement—does not occur within four or six months from the time of the injury. If the loss of power in the lower limbs immediately after the accident is not complete, recovery, complete or incomplete, may be reasonably anticipated in favourable circumstances.

Treatment of fracture-dislocation.—The first essential in the immediate treatment after the accident is to get the patient to bed, every possible care being taken to avoid increasing the damage to the cord by rough handling or unnecessary movement. The clothes should be cut away and the general condition ascertained, the symptoms of fracture being usually clear enough. Collapse, when present, should be treated in the usual way by the use of hot bottles or heated sand-bags, and, if necessary, by the administration of alcohol in the form of brandy or medical stimulants, of which ether is the best, especially when injected hypodermically, if the collapse is profound. In the application of hot bottles or hot sand-bags care should be taken that the heat is not too great, or damage may be unwittingly inflicted upon the anæsthetic parts. When available, a water-bed should be used, the best substitute being the “fracture” bed, which is easily improvised by placing one or two hair mattresses upon boards placed across the bedstead. In no circumstances should any form of soft bed, whether in the form of a spring mattress or otherwise, which allows the patient to sink into a hollow, be used. The extent of displacement should be ascertained. Very commonly—in fact, almost always in comminuted non-impacted fractures—all deformity disappears when the patient is laid flat on the back. If displacement still exists, the question of its immediate reduction by manipulation and extension arises, and must be settled at once, as if this proceeding is to achieve any measure of success, it must be undertaken as soon as possible after the accident, the object being to replace the fractured bones in their natural position, and to relieve the cord of any pressure or irritation due to their displacement. In all cases when the paralysis is incomplete or unsymmetrical, attempts at immediate reduction are urgently called for in all regions of the spine. In other cases attempts at reduction should, speaking generally, be made, especially when much pain is present from pressure on the nerves. At the same time it must be borne in mind that sudden alterations in the position of the fragments may, if violently accomplished, only result in further injury to a cord or membranes already gravely damaged. Hence attempts at reduction should be made with methodical gentleness, and should be desisted from if the end in view cannot be

accomplished without the use of great violence, excepting, perhaps, in the cervical region, where the fatal result is so certain if the displacement remains, that considerable force may be used with propriety. A mode of applying extension to the cervical spine is shown in Fig. 591. Reduction is objectless when any grave internal injury incompatible with life, such as a ruptured viscus, exists, excepting when nerve pain from pressure is very acute. In attempting reduction, no anæsthetic should be used if the injury is above the mid-dorsal region, unless there is intense pain, or if the symptoms are incomplete; and then should be avoided, if possible, in consequence of the risk of engorgement of lungs already embarrassed in their action as a natural consequence of the injury. If the use of an anæsthetic be unavoidable, chloroform or the A.C.E. mixture should be preferred to ether, in consequence of the liability

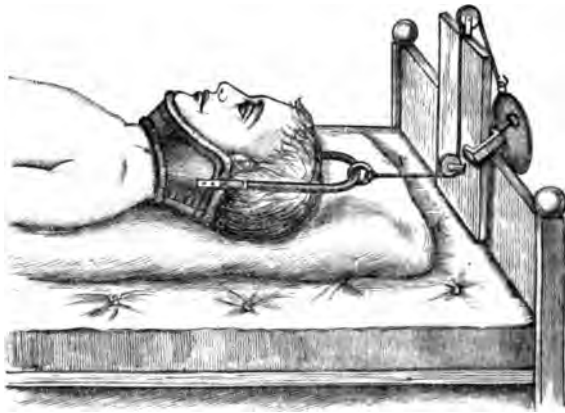


Fig. 591.—Method of applying Pulley-Extension in Injuries or Disease of the Cervical Spine.
(After Tillmanns.)

of the last-named to cause pulmonary congestion. In the cervical region immediate reduction should always be effected, if possible, and, if necessary, considerable force may here be used, as a fatal result is otherwise inevitable. In the lower dorsal or lumbar region the large size and also the direction of the dislocated articular processes may render reduction impossible without the use of violence, which may easily increase the lesion of the cord; hence in such cases operation may fairly be considered, or gradual reduction by pulley extension may be tried, although the prospect of thus effecting the object in view is, as a rule, not promising.

No attempt should be made at reduction if there is reason to believe that the fracture is impacted; in appropriate cases of this kind, however, laminectomy may be of service, a question which will be discussed later. The immediate treatment of the displacement

having been disposed of, the bladder should be emptied, as it may possibly have been some hours before the accident since the last evacuation. The palsied lower limbs should be comfortably placed, and the natural tendency to eversion obviated by the proper arrangement of sand-bags. All prominent parts should be protected from the bed-clothes by cradles, to prevent as far as possible the formation of pressure sores.

The immediate treatment having been completed, and the patient arranged as comfortably as possible, the second stage in the management of the case commences. The bladder should be emptied every four or five hours by means of a soft rubber or silk catheter—on no account should a stylet or a metal instrument be employed, unless conditions exist which render the passage of the soft instrument impossible. The bladder should be washed out twice daily, if cystitis supervenes, with a solution of boro-glyceride (3j ad Oj) or boracic acid. If the urine is foul, the internal administration of salol, betol, or benzoic acid sometimes removes the ammoniacal tendency, and clears the urine. Acid medicaments locally as a bladder wash, or administered by the mouth, are useless. When the retention is replaced by real incontinence, the catheter should no longer be employed, unless the condition of the urine renders it necessary to wash out the bladder at intervals. In introducing instruments into the bladder it must be remembered that the parts are flabby and insensitive, hence false passages are made with great facility.

Ordinary pressure bed-sores must be managed upon the usual principles of removal of pressure by felt shields, or such other contrivances as may suggest themselves, and every care should be taken to prevent their occurrence by "hardening" the skin by means of frequent applications of spirits of wine or brandy, or by painting with collodion the parts exposed to pressure. Scrupulous cleanliness must be observed, and the soiling or wetting of the parts by fæces and urine prevented as far as possible. Careful attention should be given to the condition of the bowels, for in spite of the frequent passage of small semi-liquid motions per anum, there may be rapid accumulation of scybalous masses in the colon, which are usually felt with ease, upon manipulation, through the parietes. A dose of castor oil, aided by an enema, especially if it contains rue, is generally efficient, and is usefully followed by abdominal massage. When the injury is below the mid-dorsal region, much help may be gained from strychnine, nux vomica, and pungent aromatic oils, like cajeput, given internally.

The diet should be sufficient, not too stimulating, and of an easily digestible kind. Alcohol should be avoided, unless called for by special symptoms.

If the case tends to a rapidly-fatal issue by the onset of acute bed-sore and kidney disorganisation, the difficulty of management increases materially. Peri-urethral sloughing, which rapidly extends towards the scrotum if left alone, should be treated by free perineal section, which allows the escape of foul discharges, and also drains

and in defecation. Blood swelling and the other ordinary signs of severe injury coexist.

The *treatment* consists in replacing the injured bone, which is best done by digital pressure from the rectum, and in the maintenance of rest in the flat position till union has taken place.

Gunshot and other wounds produce compound fracture, which is usually complicated by more or less extensive fracture of other pelvic bones, and generally by injury to viscera, great vessels, or nerves.

The treatment must be upon general principles. Recovery is often doubtful, and in extensive damage to vessels or viscera is frequently practically hopeless. Paralysis, slight or extensive, may result from damage to the nerves lying in the bone; ascending inflammatory changes may involve the cord.

Fracture of the coccyx is a rare injury, dislocation or bending being much more common. The causes are kicks and heavy falls backwards on to the buttocks, especially in pregnant women. Parturition has been alleged as a cause.

The bone is generally turned forwards, so that its tip projects into the rectal wall. The pain and tenderness are acute; defecation is in consequence most distressing.

The displaced bone should be returned to its normal position by combined external manipulation and digital pressure per rectum.

The displacement often recurs, and inveterate coccydynia may follow. If the difficulty in reduction is great, the fibrous parts about the bone may require division, or, as is probably better, the bone may be removed. Removal is also indicated in recurrent displacement or persistent pain.

After causing suppuration, the portion of the coccyx detached by fracture has been passed per anum.

Compound fracture of the spine.—This injury, excepting in certain cases of gunshot or other direct wounds (q.v.), is necessarily fatal in consequence of (1) the extensive damage sustained by the spinal cord, and (2) the serious injuries, to internal organs, vessels, and other parts, which almost invariably coexist. If survival follows for a time, the *treatment* is the same as for fracture-dislocation, with as much regard to asepsis in the management of the wound as the circumstances of the case allow.

DISLOCATIONS OF THE SPINE.

Frequency and position.—Probably not more than 10, or at the most 15, per cent. of cases of gross lesion of the spinal column are pure dislocations—i.e. dislocation without fracture; and the reason of this—at least, so far as the dorsal and lumbar regions are concerned—is too obvious to require explanation. It is, indeed, a question whether, even of this 15 per cent., a considerable proportion

Forceis paribus, if the rotation is in excess of the violence in other directions dislocation will occur, and *vice versâ*. The amount of violence in rotation in certain positions (especially in suspension by the head) to produce dislocation is comparatively slight, a fact well known to the professional stranglers of ancient days. Spontaneous displacement forwards of the atlas from the axis may occur in long-standing disease from softening or ulceration of the ligaments.

Prognosis of complete or incomplete dislocation.—Dislocation affecting the first or second cervical vertebrae is immediately fatal, the subject being practically "pithed." When occurring below the third vertebra, death, if it does not follow in a very short time, can hardly be delayed beyond forty-eight hours, in consequence of the onset of acute inflammatory changes in the cord.

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The *causes* are usually blows on the side of the neck, whilst the head is turned to the side opposite to that on which the blow falls. As a hunting-field accident, it is much commoner than is usually supposed, being caused by falls on the side of the head, or by blows received whilst riding under projecting branches of trees.

The *symptoms* are local pain, increased by movement; stiffness, and irregularity of the spinous processes. Pain generally radiates from the seat of injury, in consequence of the stretching or other injury to the nerve passing through the corresponding inter-vertebral canal. The head is fixed and turned towards the shoulder of the sound side. When the displacement is slight, and the disc presumably intact, no symptoms of cord lesion may be present; in other cases the signs of cord lesion range from slight tingling, formication, or feelings of "pins and needles," to complete or incomplete paralysis below the seat of injury. In any case secondary palsy may follow from hæmorrhage into the canal, or myelitis may supervene shortly after the accident, although no symptoms of any nervous lesion may have existed at first.

The *prognosis* in all cases in which distinct signs of cord lesion exist should be guarded, and, unless reduction of the displacement is effected immediately after the accident, when all symptoms in the slighter cases may disappear, is very unfavourable. In slight cases, when no symptoms of cord injury are present at first, and do not supervene after forty-eight, or at the most seventy-two, hours, the patient may be considered as safe from immediate consequences.

attempts fail. Spontaneous reduction may occur immediately after the injury, and sometimes happens after considerable intervals, all attempts on the part of the surgeon having failed; *e.g.* in a case of the writer's, spontaneous reduction occurred three months after the accident as the patient was turning in bed, very thorough attempts soon after the injury having entirely failed. The treatment of the results of partial or complete lesion of the cord, when present, is the same as that described in fracture-dislocation. After reduction, when no signs of cord implication remain, a leather collar or some other form of support should be worn for at least six months (Fig. 593).

Dislocation in the dorsal and lumbar regions.—Dislocation in the *dorsal region* without fracture is practically non-existent. If it occurs, its symptoms, for clinical purposes (excepting crepitus), are the same as fracture-dislocation, and the treatment is identical.

In the *lumbar region* dislocation, although rare, is stated to occur without fracture. At the same time, the writer is unaware of any existing pathological specimen of the injury. Dislocation of the first lumbar vertebra has been described, and successful reduction has been recorded by more than one observer, the bone having been dislocated by being thrown forwards, in consequence of violent blows on the loins in the course of falls from a great height. Upon examining the lumbar spine, it is, however, clear that such an injury without fracture of one or both articular processes must be almost impossible.

The symptoms described have been characteristic deformity, with local pain and paraplegia, complete or incomplete.

The treatment is obviously reduction, which does not seem in the recorded cases to have been difficult. The subsequent management of the case must be conducted upon the same lines as in fracture-dislocation.

Dislocation at the lumbo-sacral junction.—Displacement of the last lumbar vertebra from the sacrum occurs in rare instances, but only with fracture of one or both articular processes. The symptoms are the obvious displacement and the deformity produced by the backward projection of the upper end of the sacrum; weakness of the lower extremities; and nerve pains from the stretching or compression of the cauda equina. The treatment is immediate reduction, followed by complete rest.

Chronic dislocation at the lumbo-sacral junction (spondylo-listhesis).—In consequence (1) of fracture of the articular processes, or (2) of non-union of the ossific centres of the laminae with those of the vertebral body, a sliding forwards of the lower lumbar vertebrae upon the sacrum, from elongation of their ligamentous connections, sometimes occurs when great weight is continually brought to bear upon the fractured or imperfectly ossified bones, such as may occur during child-bearing, and in those constantly in the habit of carrying heavy burdens on the shoulders or head.

the cervical region, or of one of the other great vessels lying immediately in relation with other parts of the spine.

The damage to the bones may involve the transverse or spinous processes only. The laminae may be broken and the pedicles comminuted. When the body of the vertebra is involved the injury is usually extensive; the bone may be completely shattered, or it may be perforated by a projectile travelling at a great velocity, in some cases without opening the spinal canal. The ball may merely embed itself in the cancellous tissue (Fig. 594), or in slight cases may only groove the surface.

The spinal cord may be completely or partly severed, it may be crushed directly by the projectile, or as more often happens, by detached fragments of bone. A ball may be embedded in the bone, or pass completely through the body without opening the canal, and yet immediate loss of function in all parts below the lesion



Fig. 594.—Revolver Bullet lodged in the Body of the last Dorsal Vertebra, having grooved the anterior border of the first Lumbar, and perforated the intervening Disc. The ball entered below the Nipple, perforating the Liver, Pleura, and Diaphragm. The patient lived 24 hours. (Royal College of Surgeons Museum.)

(from so-called concussion) may follow. Compression of the cord may occur at once from the pressure of displaced fragments of bone, and almost immediately as the result of hæmorrhage into the canal.

The symptoms.—These are usually clear enough. In damage limited to the apophyses only, symptoms of injury to the cord are probably absent, excepting as the result of concussion; the entrance wound is manifest, and upon examination the shattered bone is generally found with ease.

When the vertebral body is involved with or without implication of the laminae, shock is always present, and is frequently profound; its severity depending upon (1) the level and severity of the cord lesion, and (2) the implication of the great vessels, sympathetic and viscera.

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The *treatment* consists in replacing the injured bone, which is best done by digital pressure from the rectum, and in the maintenance of rest in the flat position till union has taken place.

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The treatment must be upon general principles. Recovery is often doubtful, and in extensive damage to vessels or viscera is frequently practically hopeless. Paralysis, slight or extensive, may result from damage to the nerves lying in the bone; ascending inflammatory changes may involve the cord.

Fracture of the coccyx is a rare injury, dislocation or bending being much more common. The causes are kicks and heavy falls backwards on to the buttocks, especially in pregnant women. Parturition has been alleged as a cause.

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The displaced bone should be returned to its normal position by combined external manipulation and digital pressure per rectum.

The displacement often recurs, and inveterate coccydynia may follow. If the difficulty in reduction is great, the fibrous parts about the bone may require division, or, as is probably better, the bone may be removed. Removal is also indicated in recurrent displacement or persistent pain.

After causing suppuration, the portion of the coccyx detached by fracture has been passed per anum.

Compound fracture of the spine.—This injury, excepting in certain cases of gunshot or other direct wounds (q.v.), is necessarily fatal in consequence of (1) the extensive damage sustained by the spinal cord, and (2) the serious injuries, to internal organs, vessels, and other parts, which almost invariably coexist. If survival follows for a time, the treatment is the same as for fracture-dislocation, with as much asepsis in the management of the wound as the case allow.

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the bladder. The incision may be made without hesitation as the patient lies in the bed; the parts are quite insensitive, and no anæsthetic is required. When the patient survives the early period after the accident, escapes the onset of early acute bed-sore, and seems likely, for a time at all events, to do well, the application of a rigid support for the spine, in the form of a plaster-of-Paris or silicate jacket, leather, or poroplastic splint, is of great benefit, as it enables the patient to be turned over with greater ease and with less risk for nursing purposes than is otherwise possible. Mechanical supports of this kind can only, of course, be applied when the condition of the fracture is such in its firmness and general condition as to allow the necessary movement of the patient, without danger of disturbing the injured parts. The leather jacket is, therefore, the best, as it can be passed beneath the patient in its wet soft condition, with no more disturbance than is necessary for the ordinary nursing purposes. It moulds more accurately to the form than any other kind of splint, and is, therefore, less likely to produce pressure sores, a very important point, as the parts encircled by it are in part insensitive. Should life be prolonged for more than six months, and no signs of spinal cord irritation exist, massage and exercise for the palsied parts are indicated if the muscles respond to electrical stimulus.

Treatment of fracture without dislocation.—This is conducted precisely in the same way as the treatment of fracture-dislocation, and when the symptoms of complete transverse lesion of the cord are present the same results may, in a general way, be expected. When the loss of power is incomplete and shows no sign of increasing, the sooner a spinal jacket is adopted the better; it facilitates nursing work, and enables the patient to be moved in a manner otherwise impossible, thus diminishing the liability to pressure sores, and adding greatly to the general comfort.

In doubtful cases of fracture about the upper extremity of the spine, the strictest precautions must be taken to ensure complete rest in the recumbent position. A very thin pillow should be adjusted under the curve of the neck, the head being at the same time steadied by sand-bags, as in cases of caries. This position should, speaking generally, be maintained for from six weeks to two months, and if local tenderness or much radiating nerve pain exists after that period, the complete rest must be maintained till its disappearance, after which the leather collar shown in Fig. 593, should be worn until all stiffness has passed off, or at least until the signs of active mischief have subsided.

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The *causes* are usually blows on the side of the neck, whilst the head is turned to the side opposite to that on which the blow falls. As a hunting-field accident, it is much commoner than is usually supposed, being caused by falls on the side of the head, or by blows received whilst riding under projecting branches of trees.

The *symptoms* are local pain, increased by movement; stiffness, and irregularity of the spinous processes. Pain generally radiates from the seat of injury, in consequence of the stretching or other injury to the nerve passing through the corresponding inter-vertebral canal. The head is fixed and turned towards the shoulder of the sound side. When the displacement is slight, and the disc presumably intact, no symptoms of cord lesion may be present; in other cases the signs of cord lesion range from slight tingling, formication, or feelings of "pins and needles," to complete or incomplete paralysis below the seat of injury. In any case secondary palsy may follow from hæmorrhage into the canal, or myelitis may supervene shortly after the accident, although no symptoms of any nervous lesion may have existed at first.

The *prognosis* in all cases in which distinct signs of cord lesion exist should be guarded, and, unless reduction of the displacement is effected immediately after the accident, when all symptoms in the slighter cases may disappear, is very unfavourable. In slight cases, when no symptoms of cord injury are present at first, and do not supervene after forty-eight, or at the most seventy-two, hours, the patient may be considered as safe from immediate consequences.

When symptoms of cord lesions develop, they will almost certainly end fatally, being due either to hæmorrhage or traumatic myelitis.

Treatment of dislocations of the cervical spine.—

Having regard to the fatal termination which invariably follows complete or incomplete dislocation of the spine in the cervical region sooner or later, if left unreduced, there is no doubt that in all cases of this injury reduction should at once be attempted, especially when the cord lesion is incomplete, without losing time in the consideration of unimportant questions with reference to the possible failure of the procedure to save life. If reduction cannot be effected, it is practically certain that death will follow; on the other hand, it is equally sure that in a small percentage of cases life may be saved by immediate reduction. It therefore behoves the surgeon to give the patient such chance of life as reduction, if it can be effected, affords. Reduction may be difficult, and is sometimes impossible. The administration of an anæsthetic—preferably chloroform—is of considerable help, and should be resorted to when



Fig. 593.—Leather Collar and "Stock" for use during Convalescence from Injury or Disease in the Cervical Spine.

possible in all cases of partial cord lesion, but valuable time should not be lost in waiting. Reduction is best effected by placing the patient quite flat on the back, then, whilst the shoulders are steadied by an assistant, the surgeon, standing behind the patient's head, grasps the chin with one hand and the occiput with the other, and then makes steady traction, at the same time rotating the head first to one side and then to the other, commencing towards the side to which the head inclines, if the case be one of unilateral dislocation. If the dislocation be complete or nearly so, the head and neck above the injured point are lifted forwards whilst the assistant attempts to replace the faulty spinous process by direct manipulation. If reduction cannot be thus effected at once, it will probably be found impossible to replace the dislocated bones without an operation, a question which will be discussed under the head of laminectomy. Unilateral dislocation is usually easily reduced, but sometimes all

attempts fail. Spontaneous reduction may occur immediately after the injury, and sometimes happens after considerable intervals, all attempts on the part of the surgeon having failed; *e.g.* in a case of the writer's, spontaneous reduction occurred three months after the accident as the patient was turning in bed, very thorough attempts soon after the injury having entirely failed. The treatment of the results of partial or complete lesion of the cord, when present, is the same as that described in fracture-dislocation. After reduction, when no signs of cord implication remain, a leather collar or some other form of support should be worn for at least six months (Fig. 593).

Dislocation in the dorsal and lumbar regions.—Dislocation in the *dorsal region* without fracture is practically non-existent. If it occurs, its symptoms, for clinical purposes (excepting crepitus), are the same as fracture-dislocation, and the treatment is identical.

In the *lumbar region* dislocation, although rare, is stated to occur without fracture. At the same time, the writer is unaware of any existing pathological specimen of the injury. Dislocation of the first lumbar vertebra has been described, and successful reduction has been recorded by more than one observer, the bone having been dislocated by being thrown forwards, in consequence of violent blows on the loins in the course of falls from a great height. Upon examining the lumbar spine, it is, however, clear that such an injury without fracture of one or both articular processes must be almost impossible.

The symptoms described have been characteristic deformity, with local pain and paraplegia, complete or incomplete.

The treatment is obviously reduction, which does not seem in the recorded cases to have been difficult. The subsequent management of the case must be conducted upon the same lines as in fracture-dislocation.

Dislocation at the lumbo-sacral junction.—Displacement of the last lumbar vertebra from the sacrum occurs in rare instances, but only with fracture of one or both articular processes. The symptoms are the obvious displacement and the deformity produced by the backward projection of the upper end of the sacrum; weakness of the lower extremities; and nerve pains from the stretching or compression of the cauda equina. The treatment is immediate reduction, followed by complete rest.

Chronic dislocation at the lumbo-sacral junction (spondylo-listhesis).—In consequence (1) of fracture of the articular processes, or (2) of non-union of the ossific centres of the laminae with those of the vertebral body, a sliding forwards of the lower lumbar vertebrae upon the sacrum, from elongation of their ligamentous connections, sometimes occurs when great weight is continually brought to bear upon the fractured or imperfectly ossified bones, such as may occur during child-bearing, and in those constantly in the habit of carrying heavy burdens on the shoulders or head.

Rare in males, it is more common than is ordinarily supposed in women, in whom it is the cause of the peculiar pendulous belly with abrupt lordosis, occurring in a certain percentage of mothers of large families.

The *symptoms* are principally an unnatural shortness of stature, which makes the lower limbs appear too long; a deep hollow in the lumbar region; the chest seems to sink towards the pelvis; the sacrum projects backwards, its long axis becoming, in exaggerated cases, almost horizontal. The abdomen is proportionately pendulous, and the lumbar vertebræ can be felt projecting forwards under the abdominal parietes between the anterior superior iliac spines. There may be weakness of the lower limbs, with neuralgia, from stretching of the cauda equina. The gait is peculiarly stiff and unnatural, giving an impression at first sight of an attempt to maintain an exaggerated upright position.

The only condition likely to be confounded with spondylolisthesis is congenital dislocation of both hip joints, but in spondylolisthesis the hip joints are natural, and the characteristic waddling gait of bilateral congenital hip dislocation is absent.

Treatment effects but little permanent good. Long persistent rest reduces the deformity temporarily, and relieves for a time the nervous pain; both symptoms, however, are prone to recur when ordinary exercise is resumed. The application of a well-moulded leather spinal jacket, with crutches attached, having a good bearing from the pelvis, is the only useful plan of dealing with this curious condition when the discomfort it causes is sufficient to call for relief.

Dislocation of the coccyx.—This injury is usually caused by kicks or falls backwards on to the buttocks, especially in pregnant women. The bone is generally bent forwards, projecting almost at a right angle towards the rectum. There is acute pain during any movement, sitting is intolerable, and the passage of a motion is almost too painful to be possible. On digital examination the condition is unmistakable.

The treatment is reduction by manipulation per rectum, which is sometimes extremely difficult, and when successful is prone to be followed by recurrence; in which case by far the best and most radical treatment is removal of the bone, especially as the stretching and partial laceration of its fibrous connections frequently, even if no tendency to recurrence shows itself, leads to inveterate coccydynia.

GUNSHOT AND OTHER WOUNDS OF THE SPINE.

Gunshot wounds.—The peculiar importance of gunshot wounds of the vertebral column lies in the severe damage usually inflicted upon the spinal cord, directly or indirectly. Apart from this, however, the injury to the bones (compound fracture) is generally also serious, and rapid death may ensue from wound of the vertebral artery in

the cervical region, or of one of the other great vessels lying immediately in relation with other parts of the spine.

The damage to the bones may involve the transverse or spinous processes only. The laminae may be broken and the pedicles comminuted. When the body of the vertebra is involved the injury is usually extensive; the bone may be completely shattered, or it may be perforated by a projectile travelling at a great velocity, in some cases without opening the spinal canal. The ball may merely embed itself in the cancellous tissue (Fig. 594), or in slight cases may only groove the surface.

The spinal cord may be completely or partly severed, it may be crushed directly by the projectile, or as more often happens, by detached fragments of bone. A ball may be embedded in the bone, or pass completely through the body without opening the canal, and yet immediate loss of function in all parts below the lesion



Fig. 594.—Revolver Bullet lodged in the Body of the last Dorsal Vertebra, having grooved the anterior border of the first Lumbar, and perforated the intervening Disc. The ball entered below the Nipple, perforating the Liver, Pleura, and Diaphragm. The patient lived 24 hours. (Royal College of Surgeons Museum.)

(from so-called concussion) may follow. Compression of the cord may occur at once from the pressure of displaced fragments of bone, and almost immediately as the result of hæmorrhage into the canal.

The symptoms.—These are usually clear enough. In damage limited to the apophyses only, symptoms of injury to the cord are probably absent, excepting as the result of concussion; the entrance wound is manifest, and upon examination the shattered bone is generally found with ease.

When the vertebral body is involved with or without implication of the laminae, shock is always present, and is frequently profound; its severity depending upon (1) the level and severity of the cord lesion, and (2) the implication of the great vessels, sympathetic and viscera.

There is generally evidence of complete destruction, or partial division of the cord at the seat of injury (Fig. 595). If the cord has escaped direct damage, there may be local paralysis and loss of sensation from the division or laceration of nerves lying in the track of the projectile. When the entrance wound is near the spine, a probe or finger introduced will often detect the broken bone, and may come upon the bullet if it has not passed onwards through or by the side of the column; shreds of clothing, or other foreign material, carried inwards by the ball, may also be met



Fig. 595.—Pistol Ball fixed in Neural surface of the Arch of the Ninth Dorsal Vertebra. The patient lived for years with complete Paraplegia. (Royal College of Surgeons Mus.)

with. In complete shattering of the bone, displacement similar to that of fracture-dislocation, if not immediately produced by the injury, may be caused by disturbance of the parts in moving the patient, unless the greatest care is used. If the patient survive the immediate effects of the injury, compression from hæmorrhage, myelitis, or meningitis, separately or together, may supervene in a few hours. Later, one or more of the ordinary consequences of compound fracture may ensue—namely, abscess (possibly in the canal, giving rise to meningitis, myelitis, or compression), osteo-myelitis, septicæmia and pyæmia, hæmorrhage from sloughing, necrosis, and caries.

The **prognosis**, excepting in trivial cases of damage to the apophyses, is necessarily most unfavourable. Its gravity increases

in direct proportion to the height of the injury, and the amount of damage to the cord by partial or complete division, bruising, compression, or concussion. When no signs of cord lesion exist at first, or are very partial, and the canal has not been opened up, complete or incomplete recovery may take place, especially if the projectile has been extracted, has passed completely through the bone, or has merely grooved it externally. In the neck the probability of wound of the vertebral artery, as it lies in the foramen in the transverse processes, is an additional serious factor.

Treatment.—Unless there is coincident injury to the great vessels or to viscera, seriously endangering life, an attempt to extract the projectile should at once be made in all cases in which the wound is over the back or by the side of the spinal column. If the entrance wound is in front of the thorax or abdomen, it is hardly justifiable to subject the patient to the risks and discomfort inseparable from attempts at extraction in serious cases, in consequence of the

probability of the existence of grave visceral injury rendering the chances of survival hopeless; if the locality of the bullet is indicated by distinct swelling at the back, or, as sometimes happens, it can be felt under the skin, extraction through an incision from behind is clearly called for. The search for the projectile must be conducted upon ordinary principles. The wound should be freely enlarged, not only for the better removal of the bullet, but in order that facility may be given for thoroughly cleansing the injured parts, and to ensure the removal of all shreds of clothing, or other foreign bodies, which may have been carried into the wound. Thorough drainage must be provided, and the strictest precautions as to asepsis are urgently necessary. The symptoms resulting from the injury to the spinal cord must be treated in the manner indicated in the treatment of fracture-dislocation and injuries of the cord and membranes.

Wounds from cutting, pointed or blunt instruments (knives, swords, spears, spikes, etc.).—These, like gunshot wounds, owe their especial interest and importance to the liability of injury to the spinal cord and membranes.

Wounds from blunt bodies are commonly inflicted by the patient coming in contact with area railings, projecting iron, branches of trees, or in falling from a height. Compound fracture is the general result. The spinous or transverse processes may alone be involved, but the laminae and vertebral bodies usually suffer, in which case injury to the cord or membranes is nearly inevitable. Wounds from cutting or pointed instruments—like knives, swords, or daggers—may open the canal without wounding the membranes, or may involve the membranes and cord by passing in between the laminae without causing fracture. Generally, however, fracture of some kind is produced. The weapon may bury itself in the vertebral body without opening the canal, or may be partly buried in the bone, and project at the same time into the canal, sometimes without opening the membranes or wounding the cord. Compression may arise in such cases from hæmorrhage between the bone and dura mater without direct injury to the spinal cord.

Symptoms.—The point of primary importance is to determine whether the membranes have or have not been opened. Palsy of the parts below the injury, following immediately, is fairly conclusive evidence of damage to the cord, probably from direct wound, although it may be due to concussion, or to pressure from displaced fragments of bone. Escape of cerebro-spinal fluid is positive evidence of wound of the membranes, and if combined with symptoms of paralysis, the cord has clearly been directly involved. Symptoms of pressure upon the spinal cord coming on after a short interval are probably due to hæmorrhage between the bone and dura mater. Escape of cerebro-spinal fluid does not always follow puncture of the membranes, as the wound of the soft parts may be oblique and valvular, thus preventing the immediate issue of the fluid externally; in such cases, if the external wound heals by first intention, cerebro-spinal fluid may be confined in the soft parts until it is

absorbed. Local palsy, from division of nerves as they leave the intervertebral canals, should not be confounded with the results of wound of the cord itself.

The **prognosis** will depend for the most part upon the presence or absence of wound of the spinal cord or its membranes. In wound of the membranes without gross lesion of the cord, hæmorrhage producing compression, or traumatic meningitis are the principal immediate dangers. In the neck, sharp instruments passing between or through the laminæ and wounding the cord may cause sudden death if above the origin of the phrenic nerves, and certain although less sudden death when below that level. In gross damage to the cord in other parts from blunt bodies or sharp instruments, the general prognosis is of the gravest nature, as recovery, if possible at all, must be of extreme rarity. When palsy is only partial, recovery (complete or incomplete) may follow. Leakage of cerebro-spinal fluid is not incompatible with recovery, but acute meningitis is very prone to occur in such circumstance.

In wound of the cauda equina below the second lumbar vertebra, recovery with some paralysis may fairly be anticipated. Inflammatory changes ascending and so involving the lower part of the spinal cord may, however, lead to death.

Treatment.—When symptoms of extensive injury to the cord exist, the general treatment is the same as that for fracture-dislocation. The wound must be managed with every precaution as to surgical cleanliness; if it passes directly towards the spine, the case should be treated at first as one of wound of the membranes, whether cerebro-spinal fluid escapes or not. If no escape of fluid occurs, and if no sign of meningitis develops within a week, it may safely be assumed that no serious deep lesion exists, and the case may then be treated on ordinary principles. Sudden rise of temperature, especially if preceded by rigors, with or without symptoms of cord implication, points to the desirability of freely laying open the wound to its extreme end for exploratory purposes, and to allow of the escape of inflammatory products.

TRAUMATIC LESIONS OF THE SPINAL CORD AND MEMBRANES.

These have been already incidentally mentioned, and in some respects sufficiently described; certain points remain, however, which may be briefly dealt with here.

Lesions of the membranes.—Inflammation inside the dura mater (internal meningitis) is the only result, immediately consequent on traumatism, met with surgically. External meningitis—*i.e.* inflammation of the dura mater itself resulting in inflammatory effusion or abscess between the bone and dura mater—is rarely the immediate outcome of injury, although it is not uncommon in Pott's disease.

The causes of internal meningitis are injury, the result of

fracture or dislocation, and wounds, whether accidental or the result of operations. The most minute puncture may be followed by acute inflammation; on the other hand, large wounds through which cerebro-spinal fluid may leak for weeks, are sometimes followed by no inflammation at all.

Pathology.—The condition is, briefly, inflammation of the inner surface of the dura mater, which spreads along the loose tissue between the dura mater and the cord, thus rapidly becoming diffuse. The products of the inflammation vary from serum to pus.

The most prominent symptom is muscular spasm at first, which subsequently gives way to palsy; the spasm having been preceded by pain along the back, hyperpyrexia and probably rigors, or at least a feeling of chilliness. For example: if in a case of injury of the lower cervical region there is, as often occurs, only partial paralysis of the muscles of the arm, the onset of a spasmodic condition of the unparalysed muscles would indicate internal meningitis at the seat of injury. When the meningitis becomes diffused, the general painful spasm of the erector spinæ which follows may be mistaken for tetanus. Myelitis follows sooner or later, and accounts for the palsy which succeeds the spasm.

The supervention of acute spinal meningitis in a case of injury renders the *prognosis* very grave, if not altogether hopeless.

As to **treatment**, medical methods appear to be of little use: leeching over the spine in the early stages has been recommended, mercury has been freely given; the spinal ice-bag has been credited with success, and the cold water pack has been used, but it is not to be recommended. The rapidity with which the products of inflammation become diffused renders surgical interference practically useless.

Recovery may occur in the slighter cases with careful nursing, in patients whose constitutional powers are strong, and who can assimilate sufficient nourishment to tide them over the early stage of the disease. When acute myelitis follows, as it generally does, death is inevitable.

Lesions of the spinal cord.—The symptoms produced by damage of the spinal cord are usually so distinct, after obvious injury to the bony column, as to be hardly mistakable; but in some cases, when the signs of gross damage to the bones are absent, the diagnosis of the exact condition of the cord is not only difficult, but almost impossible.

The **symptoms** resulting directly from injury, with or without obvious bone damage, may for clinical purposes be divided into three classes: (a) those occurring immediately upon the receipt of the injury; (b) those in which only a few hours intervene between their onset and the accident; (c) those occurring after an interval varying from twelve hours to seven days or more.

(a) *Symptoms following immediately upon the accident* are due to partial or complete division from laceration in fracture, or to wounds from sharp instruments; compression, bruising, or

concussion. In the absence of bony displacement, it is impossible at first to distinguish between these several causes, excepting in the case of wounds by knives, etc. The symptoms of all are alike, namely, complete loss of function, motor and sensory, below the level of the injury, with paralysis of the sphincters.

(b) *Rapid improvement or recovery in function* is fairly conclusive evidence of shock, but may indicate hæmorrhage, and in any circumstances negatives material damage to the cord structure. Immediate partial loss of function affords positive evidence of wound of the cord, or of irritation from bony fragments pressing upon it.

(c) *Loss of power or sensation* coming on by degrees (whether rapidly or slowly) at a short interval after the accident—no symptoms of injury to the cord having occurred immediately, or if present being too slight to attract notice—is practically certain to be due either to hæmorrhage between the bone and dura mater, inside the dura mater, or in the cord itself. Radiating nerve pains especially if increased by movement, and muscular twitchings, are indicative of the bleeding being extra-dural. Patchy anæsthesia points to the bleeding being in the substance of the spinal cord.

Sudden loss of power in cases of fracture coming on after an interval is commonly due to bony displacement. If, in cases in which symptoms of injury to the cord are entirely wanting at first, or are too slight to attract attention (the patient *e.g.* walking or riding after the accident without difficulty or discomfort), progressive palsy and loss of sensation supervene in twelve hours, or after several days, acute myelitis is indicated; the occurrence of muscle spasm points to acute spinal meningitis.

In a few cases complete paraplegia may supervene after twenty-four or forty-eight hours, and then rapidly pass away, perfect recovery following. The most certain of the slight immediate symptoms of lesion of the cord are feelings of "pins and needles" in the limbs and impairment of bladder power. Symptoms of compression from hæmorrhage between the bone and dura mater may diminish steadily after the bleeding has ceased, but secondary paraplegia from myelitis follows not infrequently.

The **prognosis** in all cases of injury to the spinal cord must necessarily be serious. When the symptoms are slight, and show no tendency to rapid increase, recovery, partial or complete, may fairly be anticipated. The liability to secondary changes in the cord structure must at the same time not be lost sight of. Speaking generally, the sooner the symptoms follow the accident the better is the prospect, cases in which the primary damage is too severe for recovery to be possible being, of course, excepted. Symptoms supervening after an interval of days or weeks are generally grave, as they arise invariably from secondary changes in the cord, which are usually fatal sooner or later; at all events, if recovery follows, it is only partial, never complete; and this partial recovery is liable at any time to be succeeded by further degeneration of the spinal cord from relapsing myelitis.

Rapid increase of symptoms of compression, occurring in cases of fracture or fracture-dislocation after long intervals (several weeks, or perhaps months), may be due to pressure of inflammatory products between the dura mater and the bone. The prospect, in cases of this kind, although unfavourable, is not hopeless, if energetic surgical treatment is adopted. (*See Laminectomy.*)

The immediate **treatment** of injuries to the cord has received notice under the head of fracture-dislocation, and will be again referred to in the section on laminectomy. Pressure symptoms, presumably due to hæmorrhage between the bone and dura mater, should at once be treated by ergot internally, and later, if they increase, the question of laminectomy should be considered; but this operation to be useful must be performed early—i.e. before the commencement of myelitis. Secondary degenerative changes from sub-acute myelitis, with or without chronic inflammatory thickenings outside the dura mater, should be treated by frequent application of the actual cautery along the spine, or by flying blisters. Mercury almost to salivation, or iodide of potassium or sodium in large doses, may be useful, and certainly should be given in all cases complicated by recent or old syphilis.

Wasted muscles in cases of partial recovery should be treated by electricity and massage.

The subject of **concussion of the spine** is dealt with in Article XXXIX. (page 254).

LAMINECTOMY AND OTHER OPERATIONS IN INJURY OF THE SPINE.

1. Operations to facilitate reduction in dislocation or fracture-dislocation, or to render reduction possible when otherwise impracticable.—It cannot be denied that the great majority of cases of complete or incomplete dislocation of the spine terminate fatally sooner or later if reduction is not effected at once. It is also certain that reduction is sometimes impossible by the ordinary methods of manipulation and extension. In cervical dislocation the only chance of life lies in immediate reduction. It is, therefore, not only justifiable, but reasonable, when reduction cannot be effected by the ordinary methods, to expose the spinal column from behind by dissection, in order to make direct leverage upon the displaced bones, or even to divide or remove, if necessary, structures offering obstacles to replacement. In unilateral cervical dislocation, irreducible by the usual plans, reduction may be attempted in the same way, if distinct evidence of lesion to the spinal cord exists; in the absence of symptoms of cord injury, operation is as a rule uncalled for, especially as spontaneous reduction may occur even after long periods.

In fracture-dislocation in any region of the spine, when reduction cannot be otherwise effected, exposure of the injured bones to facilitate replacement is indicated, unless there is evidence of

complete destruction of the cord at the seat of lesion, when the operation may for practical purposes be held to be useless.

2. Operation in recurrent displacement.—In cases of recurrent displacement in fracture-dislocation, when there is sound reason for believing that the cord has not been completely divided or

hopelessly crushed at the seat of injury, it is a question for legitimate consideration whether the bones may not be advantageously fixed in position by wiring together the separated laminae, spinous processes, or pedicles in the manner sometimes practised after laminectomy.

3. Operation for the relief of pressure on the cord from displaced fragments of bone, hæmorrhage between the bone and dura mater, or inflammatory products in the same situation (laminectomy).—This operation in proper cases is right and reasonable. In fracture-dislocation it can rarely alone effect much good, as the symptoms of pressure or irritation are in no true sense likely to be relieved by the removal of the laminae *only*, since they are mainly due to the backward pressure on the cord from the displaced fractured bodies forming the anterior wall of the vertebral canal. If, therefore, practical relief is to be given, not only must the laminae be removed, but the backward projection caused by the fractured bodies must be gouged or



Fig. 596.—Fracture of the Spine treated by Urban by Resection of the projecting pre-medullary angle. (After Urban.) (From Chipault's "Études de Chirurgie Médullaire.")

chiselled away, an operation which—although it has been performed (Fig. 596)—is so severe and prolonged that a favourable result could hardly accrue in ordinary circumstances; and certainly not if any material damage to the cord were present, as increase of the damage must be almost unavoidable in the disturbance of the parts necessary for the performance of the operation. It is at present, therefore, doubtful whether this proceeding should be included amongst the rational operations of surgery.

Laminectomy in hæmorrhage is in appropriate cases not only justifiable, but may be clearly called for to afford the only possible chance of life by the removal of the clot, with the double object (1)

of relieving the immediate compression and (2) of preventing the subsequent fatal myelitis, which is otherwise almost inevitable. In cases, therefore, in which the symptoms of pressure from hæmorrhage between the bone and dura mater are sufficiently precise, and are increasing, or even stationary, laminectomy should be performed and the clot removed, which can of course be done without opening the dura mater, the operation being on that account less severe than it may at first sight appear. Laminectomy for the removal of inflammatory products, although sometimes useful in caries, must rarely be called for in cases of injury, as the only inflammatory condition following immediately upon traumatism is acute internal spinal meningitis, which becomes too rapidly diffuse to be arrested by any surgical proceeding at present devised.

When in cases of long survival after fracture or fracture-dislocation, with partial loss of function, rapid or slow symptoms of compression supervene from extra-dural inflammatory effusion or abscess, laminectomy is strongly indicated.

4. The use of sutures in wounds of the spinal cord.—The introduction of sutures in order to bring together the separated ends of the cord after complete division by sharp fragments of bone, or by cutting instruments, has been suggested and experimentally practised. So far as our present knowledge allows of any judgment being formed, it is difficult to see how this proceeding is to be brought within the confines of legitimate surgery. At all events, it could only be applicable after division of the cord by sharp instruments—a lesion of extreme rarity. It is clear that the soft structure of the cord itself would hold no suture without rapid degeneration following, and the approximation of the divided nervous parts by suturing the membranes must obviously be too imperfect to afford any prospect of success. It is possible that, in division of the branches of the cauda equina, re-union by suture inside the canal may in the future effect some good, in the same way as the suture of other nerves; but whether the probability of benefit will be sufficient to justify the severity of the operation (laminectomy) necessary to expose the divided nerves, is more than doubtful. At present, at least, it may be safely said that attempts to re-unite by suture divided nervous tissue inside the vertebral canal, are incompatible with prudent surgery.

XXXIX. CONCUSSION OF THE SPINE.

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TRAUMATIC NEUROSES—RAILWAY SPINE.

IN speaking of a "traumatic neurosis," it is commonly implied that as the result of injury there is disorder of function of the nervous system or one of its parts, in which the symptoms are prone to simulate those due to organic disease, but are nevertheless independent of gross lesion. When a man has broken his back, and his spinal cord has been crushed at the same time, he is of necessity and in a strict use of the term, the subject of a traumatic neurosis. It is not, however, to such injuries or to any allied condition that the term is ordinarily given; it is rather meant to indicate that as the consequence of an accident, in which, perhaps, no precise injury has been sustained, there exists some disorder of nervous function alone.

I propose to consider the subject in connection with *railway accidents*, for the reason that, although it is not by any means after railway accidents only that traumatic neuroses are to be seen, such accidents give rise in Great Britain at any rate to some of the best and most striking examples. Experience shows that certain *contributory causes* may have much to do with the manifestation of functional nervous disturbance after injury. Amongst them may be named as most prominent the inheritance or acquirement of general nervous instability, often spoken of as nervous temperament; the occurrence of mental shock at the time of the accident, and at a later period in the history, anything of whatever kind which tends to keep up the invalid state and foster a belief in the hopelessness of recovery. A consideration of the events of most railway collisions is enough to show that mental shock must necessarily play a large part in determining the condition of anyone who has been exposed to them. The noise and the crash, the sense of impending catastrophe, the utter helplessness, the cries of the injured, the uncertainty of what may happen next, and it may be the awful nature of the whole scene, may cause sufficient terror to produce undoubted shock from this purely mental cause alone. This happens

even when no bodily injury has been sustained, so that a man may fall into a state of collapse, or show immediate indications of the effect of the accident upon him by outbursts of acute hysterical excitement; or he may pass into a state of daze or semi-unconsciousness, in which his words and actions are completely uncontrolled. Herein may be the beginning of an illness in which some disorder of nervous function, showing itself in various bizarre ways, may be the most pronounced fact.

It is rare, however, to meet with cases of which it can be said with certainty that there has been no physical injury at all. Sprains and bruises are common, and the mode of the accident, the collision of two opposing bodies with greater or less force, is such as to jolt the passenger from his seat, and in the sudden violence of the movement he is very prone to receive a sprain of some part of his spinal column. Very probably his first complaint is of *pain in his back*, and it was doubtless by reason of the exceeding frequency of this particular form of injury that the phrase "railway spine" came into vogue. Furthermore, it was the very frequent association of nervous disturbance with spinal pain which no doubt led originally to the belief which held sway for many years, that the symptoms of the nervous disorder, whatever it might be, were due to injury or concussion of the important parts of the central nervous system which occupy the spinal canal. And so it came to pass that cases of spinal injury after railway collision were often spoken of as "concussion of the spine," a term which, whether it was meant to imply it or no, unavoidably suggested that there had been injury to the spinal cord from concussion, much in the same way as the brain may be injured by the force which is termed concussion from a blow on the head.

In this Article it is not intended to bring forward the evidence, which is conclusive, and which may be found elsewhere, as to the absence of intra-spinal injury in the vast majority of the cases where there is complaint of spinal pain. It must suffice to remind the reader of the fact that the physical relations of the spinal cord and the bony canal in which it lies are wholly different from those of the brain and skull, and that they do unquestionably protect the cord from the injurious effect of blows on the back, such as, were they to fall upon the head, would be likely to cause concussion of the brain. It may, indeed, be said at once that concussion of the spinal cord is one of the very rarest of injuries, and that, as the writer has shown in another place, railway collisions are not especially prone to provide examples of it. "Concussion of the spine" and "railway spine" are, therefore, bad and most misleading terms to employ in speaking of the kind of spinal injury which is common in railway accidents; and they are still worse to apply to the general effects upon the nervous system when there is no accompanying injury to the back. The height of absurdity is reached when either the one term or the other is used for a functional neurosis in which there is nothing wrong with the spine, and the person suffering has not even been in a railway accident.

The spinal injury from a railway collision, as the mode of occurrence and the symptoms alike show, is, in the great majority of cases, a simple sprain of extra-spinal structures; of the muscles which, running from one part of the column to another, bring about the movements of which the spine is capable, the ligaments which bind its various parts together, and the fasciæ which embrace the whole. And as we see that sprain of other movable parts of the body causes stiffness and pain, so is it of the spine, and spinal stiffness and pain are the common indications and complaints. These symptoms may vary widely both in range and degree, from the weary aching and pain of a slight lumbago, to the stiffness and pain which involve the whole spinal column, and render the simplest movements impossible.

It is hardly surprising that the sufferer from this form of sprain, his mental balance being already unhinged by the alarming events of the accident, should come to think that he has met with some very serious injury, and that the symptoms of it, being often obscure, should tend to increase his depression of mind. Nor is this estimate of his condition likely to be lessened if the onset of the spinal pains is delayed for several days, or if at first they become worse and more widespread. This is a frequent thing in ordinary lumbago, and it is not less so in the traumatic lumbago which we are now considering. As in ordinary lumbago, so also in this form of it induced by violence, the pain is very prone to radiate widely from the seat of injury, and in the track of no special distribution of nerve, to run upwards and downwards along the spine, over the muscles on each side of it, and down the legs.

Moreover, there may be distinct *tenderness* at one or two points of the spine—over spinous or transverse processes, or the lateral muscles—where the sprain has been most severe; and on trying to walk the patient finds that he can hardly do so, his legs feel weak, and he cannot hold himself upright. The general muscular incapacity may, indeed, be such that there is difficulty in micturition, and the bowels are confined, because the act of defæcation induces spinal pain. The combination of symptoms very naturally induces a *dread of paralysis*, and a belief that there has been serious injury to the spine, and to the vital structures which are within it. And out of this groundless fear, and the concentration of the thoughts upon the back and spine, there now originates, in many cases, an extreme degree of *surface hyperæsthesia*, so that the patient flinches at the lightest touch. His flinching and contortions give the needed opportunity of observing the mobility of his spine, wherein lies a diagnostic sign of much value, for if the well-recognised indications of injury to spinal cord or spinal nerves have been carefully excluded, and if due account has been taken of the spinal pain itself, and of the fact that the spinal column nowhere shows the degree of rigidity which is associated commonly with organic disease, the hyperæsthesia of the surface is a pretty sure indication of the nature of the case with which we have to do.

It is very necessary, too, that a correct diagnosis should be made, for the treatment of the two conditions is wholly different. In the event of organic injury to spine or intra-spinal structures, the part must obviously be kept at perfect rest, but in that of a purely neurotic condition, grafted upon some trivial extra-spinal injury, few things could be much worse than keeping the patient long in bed, and anything like fixation of the spine in jackets is pretty sure to do harm. The stiffness is thereby perpetuated, and with it the pain of movement. In movement, indeed, lies the appropriate line of treatment; and as it is often seen in the case of the sprained joint of a limb that movement, at first passive, becomes active, and gradually brings with it the power of greater movement, and at the same time diminution of pain, so is it in the case of sprains of the spine, all its lumbago-like symptoms will disappear under the influence of movement. Every care must of course be taken not to begin movement too soon, or until there has been time for repair of the injury to ligamentous and muscular structures outside the column; and where there is the smallest doubt, it is better to err on the side of too long rest than to do harm by movement when rest is imperative.

We may pass on to a consideration of the state of *general nervous prostration*, or *neurasthenia* as it is sometimes termed, which is so often met with after railway collisions, be it either with or without some definite physical injury to the back or other part of the body. And here, in the first place, a very singular fact is to be noted, that in those cases where a severe injury, such as fracture or crush of a limb has been sustained, and has been followed by the usual signs of shock, it is not nearly so common to see the evidences of general prostration afterwards, as in those cases where there was no physical injury, and the immediate signs of collapse were only slight. The explanation of this anomaly lies, in all probability, in the fact that in the one case the collapse is dependent in great measure on the injury sustained, and is coincident with its immediate consequences, while in the other and more common cases the signs of shock are likely to be delayed in their manifestation, being warded off by the excitement of the scene. They are not, however, prevented—they are merely postponed—and they even seem to gather fresh force, and to be changed in character, by the delay. Thus it often happens that the patient holds up until he reaches home, and then for the first time completely breaks down. You are summoned to see him, and you find him with cold extremities and a feeble pulse, and in a condition of undoubted collapse. He rallies to some extent, and derives hope from the fact that no bones are broken, and that he is otherwise physically unhurt. In a day or two he goes to business much as usual, but soon finds out that he has neither the strength nor nerve for it which he had before. He begins to ache all over, and to have pain in his back and head; he loathes his food, and cannot sleep; he feels weak and prostrate, and ill. He is now at a distinct disadvantage in comparison with the man who has met

with some definite physical injury, and who, likewise, has rallied from the state of collapse, profound even though it may have been at first. In this case the injury is definite, and the measure of it can very probably be taken at once. Furthermore, it compels the patient to stay in bed, and he is doomed from the first to abstain from work. And while his physical injury is being repaired, his nervous system is also having perfect rest. The other and less fortunate man, however, has had the mortification of breaking down at his work, when he had fully believed he had escaped all injury. This comes as a recurrent shock to his nervous system, and if there be superadded, after the lapse of a few days, the obscure pains in the back and other parts of the body which have been described, there is yet another cause for the symptoms of nervous prostration which now become prominent. It is to this condition that the term "traumatic neurasthenia" is commonly given, and it is essentially one of the traumatic neuroses.

The prevailing indications of this state are general bodily enfeeblement and sense of weakness, so that any kind of work—whether mental or bodily—is performed with difficulty, and gives rise to early and undue fatigue. Sleep is bad, and there is often pain or a constant feeling of oppression or weary heaviness in the occipital region, the tongue is foul, and there is an abhorrence of food. Nausea and sickness and constipation are common; the urine may be feebly alkaline and charged with phosphates; and in women there is frequently much derangement of the catamenia, complete suppression being the most frequent. The patient is irritable and ill-tempered, suffers from palpitation, and cannot bear the least disturbance or noise; mental occupation increases the discomfort in the head, he cannot concentrate his thoughts upon anything—himself excepted—for any length of time, and he complains, therefore, that he has lost his memory. Sight seems to fail him, because the effort of ciliary accommodation is soon followed by fatigue; he loses flesh and looks wasted, anxious, and ill. Depression is the main and most prominent feature in this general state of malaise, and depression and despondency of mind are common. A vicious circle is soon established, in which loss of healthy nervous tone, both in the conscious life of the individual and in the unconscious and insentient working of the various inorganic processes of the animal economy, leads to serious derangement of function in the various parts of the system. Derangement of the processes of digestion and assimilation is, perhaps, the most injurious, and often the most pronounced, so that in turn the entire nervous system itself suffers from malnutrition, by the deprivation of healthy blood. It is not surprising there should be great mental depression; and want of sleep comes to increase the whole train of symptoms. Return of natural sleep is indeed one of the surest signs that a healthy nervous tone is returning, and that the vicious circle is being broken down. The want of sleep is peculiarly distressing, for in the solitude of the night the patient broods over his ailments,

and each day is begun with a sense of fatigue and of renewed despondency. It also opens up the temptation to treat the condition by the administration of narcotics, which are almost certain to do more harm than good. This is very strikingly so in the case of bromide of potassium, which, having the false reputation of being a harmless drug, is perhaps chosen as suitable to bring comfort and repose by repeated doses in the course of the day. Let it not be forgotten, however, that the base potassium is a powerful cardiac depressant, and that the prolonged administration of the salt is almost sure to induce the very symptoms which we are wishful to remove. It is not by drugs of the kind that convalescence will be started, but by the judicious administration of food in such quantities, and at such intervals—at frequent intervals if the patient cannot take his ordinary meals—that the bodily nutrition shall be maintained. Thus fortified, the invincible tendency of the nervous system to regain its healthy tone will assert itself, and recovery will ensue. This brief survey of a peculiar clinical state is enough to show that the matter of treatment may be one of no small difficulty, and that it is, above all things, desirable to get rid of every obstacle to the requisite effort which the patient must himself at some time make to throw off the invalid state. There is no kind of functional nervous disturbance in which the influence of the mind upon the body is more marked than it is in this, in which “expectant attention” is so potential of evil, or in which the despondency and depression, naturally felt by an active man from want of occupation and work, are so prone to react upon and multiply the physical ailments, to which his mental condition leads him to attach an importance far beyond their actual reality and significance.

The consideration of some even more remarkable effects of railway collision upon the nervous system may next engage our attention; effects which may be either immediate or remote. Amongst the former are those manifestations of nervous disturbance often spoken of as “*hysteria*,” and when following injury known as traumatic hysteria. Acute attacks of convulsive crying and sobbing, in which all control of the emotions is for the time lost, may come on directly after the accident, and need not in the circumstances cause surprise. But more strange, and in their nature less explicable, are those states of *semi-unconsciousness* or daze, which may be altogether independent of any blow upon the head. Fright is the exciting agent of this peculiar state—a state in which the individual may perform apparently purposive acts, but may, nevertheless, be wholly ignorant afterwards, and may give an absolutely erroneous account of what he has done. The condition is in all probability allied to that of hypnosis, which may be purposely induced by experiment, both in man and animals, and is of a sufficiently grave character to show that a serious effect of some kind has been wrought upon the higher regions of the sensorium. Associated with it, either immediately or at a later time, may be some more definite local condition of nervous disturbance, such as paralyses and pareses of motion and

sensation, convulsive seizures, and the like. All of them belong to that type of disorder which is frequently spoken of as hysterical, in that the particular symptoms are independent of organic disease, and that they are prone to pass away without leaving any trace behind. In speaking of them, however, as hysterical, we must be careful not to imply that they are unreal, though many of them doubtless border on the confines of fictitious disease. Their mode of origin is itself sufficient to suggest that some unnatural cerebral condition underlies them. The particular manifestation, be it convulsive or paralytic, is, in fact, the local expression of a disturbance in the most highly organised parts of the central nervous system; and it may be said at once that hysteria is essentially a functional disorder of the cortex of the brain.

It is under conditions such as these that we are likely to meet with those kinds of nervous disorder to which the term "traumatic neurosis" is often limited, and to which it is, perhaps, more applicable than to any of the states which have been previously considered. In the domain of motor paralysis, for example, it is not uncommon to meet with paraplegia, a purely functional inability to move the legs, and only rarely accompanied by paralysis of either bowel or bladder. The limbs are often cold, and the circulation in them is obviously sluggish; but nutrition is not seriously affected, there is no unilateral wasting, and the deep reflexes, though from time to time increased, are never in abeyance.

Correct diagnosis may be difficult, and a very careful attention must be paid to the symptomatic value of any concomitant spinal stiffness or pain. A clue to the actual condition may often be found in an examination of the state of cutaneous sensation or of the special senses. In paraplegia, for instance, some impairment of sensation may be discovered at some part of the limbs; but it seldom follows the distribution of any spinal nerve, and rather has a tendency to affect the limb below the level of a line which may be drawn round it at some arbitrary point. In hemiplegia also, or the monoplegia of a limb, it is by no means uncommon to find that some sensory disorder of this kind accompanies it.

A pronounced condition, moreover, and one that is perhaps unknown to the patient himself until discovered in the process of examination, is that known as "*hysterical hemianæsthesia*," in which there is more or less impairment of sensation over one half of the body, with affection of the special senses on the same side, taste, hearing, and smell being alike diminished, with contraction also of the field of vision and impairment of the sense of colour. The discovery of one or other of these sensory disorders is of supreme importance for diagnosis, as indicating that in all probability it is a functional neurosis with which we have to do. The discovery hardly makes treatment easier, but, at any rate, it enables us to avoid that which is likely to be harmful.

And in a few words it may be said that that line of treatment is almost sure to be the worst which acts on the assumption

that we have to do with a case of organic disease, calling for confinement to bed, and for all the methods adapted to a severe illness. That this condition of hemianæsthesia is independent of gross structural lesion is shown in exceptional cases by its immediate onset after the terrors of a railway accident, without any physical injury having been sustained ; while the frequently sudden disappearance of the phenomenon, or its transference from one side of the body to the other under influences which may be exerted when the sufferer is in the hypnotic state, all point in the same direction.

Fright alone may have been sufficient to call one or other of these neurotic conditions into existence ; but experience shows that a neurotic temperament, either inherited or acquired, acts as a powerful predisposing cause. Antecedent states of health or habits of life may also have considerable influence in determining the outbreak of some severe functional nervous disturbance after adequate exciting cause. Thus, the man who has been working at high pressure in his business without proper rest, the alcoholic, and he who has given way to sexual excess, are very prone to suffer from the fright-effects of a railway collision, and even though there may be no instantaneous indications of wrong, to feel them presently in a severe degree. This fact has had much to do with the erroneous idea that the effects of this particular form of accident are likely to be remote in point of time from the cause which originally produced them. A state of uncertainty and apprehension is thereby engendered, which, continually suggesting the probability of impending serious illness, is the fertile parent of all sorts of imaginary ailments. The back is stiff and the legs feel weak from causes which have been already named, and it is perhaps suggested by some anxious and meddling friend that the man will probably become paralysed. The fear of this so preys upon his mind that presently the weakness of the legs, and the fear of moving because of the pain induced, develop into an actual paraplegia, of which the underlying cause is not a lesion in the spinal cord, but a purely functional arrest of some one or more of the higher cerebral processes concerned in movement and sensation of the lower limbs, which feel numb and cold from feeble circulation or simple disuse. And as we can trace the development and progress of a purely functional paraplegia, so may we sometimes see the origin of kindred nervous disturbances in other parts of the body. Abnormal sensations have been determined by slight physical injury, the import of them is misjudged, apprehension increases as they continue day by day, and they become the basis of the special symptom which supervenes. Here we have the "traumatic suggestion" of Charcot, which needs for its full effect the cerebral state which may be directly induced by the terror of the accident, or indirectly by the events which follow, and to which reference has been made.

Experience has, moreover, shown that one of the chief impediments to recovery is the unsettlement of mind which arises from the harassment and uncertainty incidental to litigation and disputes as to the compensation to which, in the case of railway injuries, all

sufferers think themselves legally entitled. It is a matter of everyday observation that improvement usually begins as soon as the claim for compensation has been arranged. It is, however, not necessarily correct, and it may be often unjust to assume that because a man began to recover as soon as he received compensation he must perforce have been malingering before. Whatever may be the precise form of it, the very nature of the disorder itself is such as to make it prone to be kept alive by anything which leads to introspection and uncertainty of mind. No doubt a patient sometimes uses the opportunity of any dispute about compensation as an excuse for not making the requisite effort to put away the invalid state; but it is quite as likely to be the fact that the anxiety which a man rightly feels as to his compensation being adequate both on his own account and on that of his family, tends to make him dwell upon his ailments and look forward with little hope to recovery. At any rate, it is a fact which cannot be gainsaid, that the troubles and delays incidental to disputes or litigation as to the settlement of a claim have a most retarding influence on the progress to recovery, and that he who would treat these cases with success must have the good sense to bear that fact in mind. The patient himself is usually the worst judge of his own ailments, and often his own worst adviser in all matters bearing on the question of compensation; and it is for his medical attendant to show courage in guiding him to recovery by paying due regard to this most potent element in the features of the case.

In ending this Article, it may be said again that the conditions which have been described and the influences which are at work in these cases of traumatic neurosis are in no wise peculiar to the effects of railway injury, but that they may occasionally be seen after any and every form of accident to which man is liable.

XL. DISEASES OF THE SPINE.

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Spina bifida (split-spine). *Definition.*—A hernia-like protrusion of the membranes of the spinal cord through a congenital cleft in the posterior wall of the vertebral canal.

Ætiology.—The only cause assignable of spina bifida is defective closure of the posterior vertebral arches, the main factor in the defect being an insufficient ingrowth of the mesoblast on each side, which should, if completed, cover in the spinal cord and ossify, after the epidermis has been produced by the superficial epiblastic layers, the intervening soft parts being normally formed by a similar ingrowth of mesoblast.

Pathological anatomy. — By the protrusion of the membranes through the cleft in the vertebral arches a cyst-like tumour is produced, more or less distended by cerebro-spinal fluid. Into this protruding sac the spinal cord, normal or modified, extends in the majority of cases (62 per cent.).

Three principal varieties of spina bifida are usually recognised—(1) *Meningocele*, the sac containing the spinal membranes only; (2) *meningo-myelocele*, the sac contents being the cord and membranes; (3) *syringo-myelocele*, in which the spinal cord, distended by enlargement of its central canal, forms a neural lining to the sac.

Recently two distinct classes of spina bifida have been described by Hildebrand of Göttingen. In the first all the posterior structures are cleft; bone, dura mater, pia mater, cord, and overlying soft parts, the result being myelocele (caused by hydrops). The pia mater is pushed backwards in the form of a sac, so that its inner surface becomes the outer surface of the sac; upon this the cord lies embedded, a depression in the sac indicating the place of insertion of



Fig. 597.—Pedunculated Spina Bifida.

the cord within. In the second class the cord, pia mater, and arachnoid are closed, but the dura mater and bone are cleft. The hydrops may be in the cord (myelo-cystocele), or it may be between the pia and arachnoid (meningocele); in the latter case the covering of the sac is formed either by the dura mater and arachnoid together, or by the dura alone.

The defect in the bone is due to absence of the spinous process, the laminae being wanting or defective; the rest of the bone is almost



Fig. 598.—Spina Bifida with broad Base, showing the Transition from the normal Integuments to a thin Membrane over the Apex of the Tumour. (From a photograph.)

always normal. In rare instances the body of the vertebra has been met with displaced from its natural position; it may be cleft, an *anterior* spina bifida resulting. The bony defect varies in width from a narrow fissure to a gap as wide as the vertebral canal. Vertically, one vertebra only is very rarely involved; usually two, three, or four arches are concerned, and the whole length of the column may be cleft (Fig. 599).

In about 10 per cent. of the cases the *sac contents* consist of cerebro-spinal fluid only. Commonly, the tumour contains either the spinal cord, apparently normal or modified; the whole or part of the cauda equina; isolated nervous bands scattered over the sac wall, or a single bundle of nerve fibres (Fig. 600). Excepting when the

distended cord forms a nervous lining to the sac, the nerve structures tend to lie in the median line, the sides of the tumour being free. Very rarely the sac contains masses of fat or fibrous tissue.

Situation.—Spina bifida is commonest in the lumbo-sacral region. It may affect the cervical spine, especially in the upper part. The rarest site is the mid-dorsal. The deformity is nearly always single, but more than one region—*e.g.* the lumbar and cervical—may be affected separately at the same time. Three distinct tumours have been seen—one in the lumbar, sacral, and cervical region respectively. When, however, two regions of the spine are affected simultaneously, it is more commonly by a large extent of deformity than by multiple defects.

Symptoms.—A congenital tumour (Fig. 597), varying in size from that of a cherry to a coconut in the middle line immediately over the posterior aspect of the vertebral column, closely connected to the subjacent bones in which a distinct gap is usually felt upon raising the tumour, which is more or less tense, smooth, distinctly fluctuating, and often translucent wholly or in part. The non-translucent portions are those covered by normal skin, and the area to which the nervous elements are attached inside the sac. The integuments may be natural, but generally the skin passes on to the base and sides of the tumour only, and then merges into a thin semi-transparent membrane, forming the apex of the sac, which is the outcome either of imperfect development or of stretching of the peripheral parts of the sac wall by its contents as they increase in bulk (Fig. 598).

The tumour is usually pedunculated, but may be sessile; its size and tension increase during crying or exertion, and in the erect position. It is usually more or less compressible, especially when the communication between the sac and membranes is large. Persistent pressure may cause convulsions, and when hydrocephalus co-exists,



Fig. 599.—Extensive Spina Bifida involving the Dorsal and Lumbar Regions. (St. George's Hospital Museum.)

pressure on the tumour causes increased tension at the unclosed fontanelle. In extreme cases fluctuation may be felt between the fontanelle and the sac.

The tumour is usually smooth, but may be irregular, or (very rarely) multilocular (Fig. 599). It may be flaccid or shrivelled from the existence of a small opening in its apex, which allows the fluid contents constantly to drain away. The integuments, upon which a nœvus is generally found, may in old-standing cases be corrugated or rugose, and are sometimes bossy with calcareous thickenings.

Convulsions are common. Hydrocephalus, talipes (generally

equino-varus), paraplegia, strabismus, and nystagmus, are frequent symptoms of gross nervous lesions. Anæsthesia or hyperæsthesia may in rare cases exist below the deformity.

In an ordinary case the character of the tumour, its history, and position, coupled with the obvious communication between it and the spinal canal, make the *diagnosis* easy, especially if signs of nerve lesion exist. When the communication between the cyst and canal is very small, the difficulty of distinguishing spina bifida from congenital tumours unconnected with the spinal membranes is often almost impossible in



Fig. 600.—Spina Bifida laid open to show Nervous Structures crossing the Sac. (St. George's Hospital Museum.)

the absence of symptoms of nervous lesion, especially if the cyst is thick-walled and irregular, and when no cleft in the bone is perceptible. Other congenital tumours, however, are rarely exactly in the middle line, and are frequently multilocular, which is the rarest characteristic of spina bifida.

Prognosis.—Spina bifida usually ends in death by convulsions, inflammation or suppuration after bursting of the sac, or marasmus produced by the continual draining away of cerebro-spinal fluid. In a few cases the tumour ceases to grow, or may even shrink, life being prolonged for years, rarely beyond the time of puberty; the age of fifty has in a few cases been reached. When the tumour is well pedunculated, and the communication with the membranes small, a cure may be effected by spontaneous closure of the communication, and recovery may also follow spontaneous rupture of the sac.

Speaking generally, the prospect of survival increases in direct proportion to the amount of pedunculation of the tumour, the small size of the communication with the membranes, the density of the cyst wall, and the absence of symptoms of nervous lesion.

Treatment.—In the absence of urgent symptoms, the longer active treatment is delayed the better is the prospect of permanent good from its use. In the earliest periods of life the treatment should, therefore, be *palliative*, the main objects being (1) to protect the tumour from injury and irritation, and (2) by the application of pressure to attempt to arrest its growth, and to lessen the chances of spontaneous rupture. A pad of wool or a wash-leather cap firmly held in position by a flannel binder is generally all that is necessary. If the integuments are healthy, a vulcanite, metal, or celluloid mould made upon a cast of the tumour is most efficient. The application of collodion upon the tumour, although recommended, should be avoided; the irritation caused by its rapid evaporation is far in excess of any good effect produced by the pressure resulting, which is practically nil. If used at all it should be diluted with one quarter of its bulk of castor oil. When healthy, the surface of the tumour should be kept dry by the use of a simple dusting powder like calamine; when inflammation is present or threatening, an unirritating ointment or sedative lotion may be substituted. Spontaneous rupture of the cyst should be treated as a recent wound with every regard to asepsis.

One of the following methods of *curative* treatment may be rendered necessary at any time by rapid increase or progressive inflammation in the tumour; and in patients who have survived the affections incidental to childhood, may be adopted for the radical cure when the tumour has ceased to grow, and shows no sign of shrinking.

1. *Acupuncture* by repeatedly pricking the thin portion of the cyst wall with a fine needle, the fluid being allowed to ooze away into an antiseptic dressing; this method is especially suitable for slowly increasing tumours in young children.

2. *Simple tapping* of the cyst through the normal integuments around its base with a fine trochar and cannula repeated at intervals, not more than two drachms of the fluid contents being drawn off at each tapping; gentle pressure is afterwards maintained by a pad of wool, the puncture having been sealed with collodion; this method is suitable for rapidly increasing cysts in children.

3. *Injection* is certainly the most successful plan in the majority of cases. Many forms of injections have been used; those containing iodine are best. Morton's fluid (iodine, 10 grains; iodide of potassium, 30 grains; glycerine, 1 ounce) has given the best results. Two drachms of fluid withdrawn from the cyst through a puncture made in the healthy skin around the base of the tumour are replaced by the same quantity of the injection; gentle pressure is subsequently applied, and the injection repeated at intervals of from three days to a week so long as improvement continues (Fig. 601).

Recoveries have also followed the introduction of tincture of iodine and crude carbolic acid into the sac.

4. *Extirpation by the knife.*—In patients who have survived the early years of life this method offers in suitable cases a prospect of cure unobtainable by any other plan. Extirpation is *unjustifiable* (a) in very young infants; (b) in cases complicated by extreme hydrocephalus, paraplegia, or other signs of serious nerve lesion;

(c) when the disease is very extensive, if the normal skin is so deficient that its approximation across the cleft is impracticable. Extirpation is *justifiable but undesirable* (a) when the tumour is covered with normal integuments, is not increasing, and gives rise to no trouble beyond the inconvenience of its existence; (b) when the disease is very extensive, the normal skin being sufficient to allow of its approximation across the cleft.

Extirpation is *indicated* in subjects over seven or eight years of age in whom the tumour is increasing or threatening to burst and no serious nerve symptoms exist, the cyst being thin-walled, pedunculated, and presumably free from nerve tissue, the normal skin



Fig. 601.—The Case of Spina Bifida illustrated in Fig. 598, six weeks after two injections of Morton's fluid. (From a photograph.)

about its base being sufficient to be easily united across the cleft.

The presence of the spinal cord in the cyst is no absolute bar to operation, as it may be dissected away from the cyst wall, and pushed back into the vertebral canal.

After removal a pad or metal shield should be worn as a truss to support the defective part.

The treatment of spina bifida by means of the ligature, cautery, electric or otherwise, and caustics is intentionally not discussed, as it is inconsistent with the principles of modern surgery. Moreover,

the improbability of benefit being derived from either of these methods is so great that the risks entailed by their use are unreasonable.

Spina bifida without tumour.—Defective closure of the vertebral arches is sometimes unaccompanied by protrusion of the membranes; to this condition the term *spina bifida occulta* is applied. In slight cases the deformity may be undetected; or the cleft, if very narrow, may be mistaken for bifid spinous process: the slightest indication met with of a tendency to this deformity is a small dimple in the middle line over the lumbar or sacral region. An excessive growth of hair occurs over the cleft in many cases, and is an important guide to the deformity. *Spina bifida occulta* gives rise to no symptoms as a rule, and requires no treatment beyond a support to the part if any weakness exists. If signs of nerve lesion be present, it is clear that local measures can effect no good.

False spina bifida.—This term, if retained at all in surgical nomenclature, should be confined to the tumour remaining after the neck of a spina bifida has either become obliterated or is, at all events, so small that no apparent communication with the spinal membranes exists; it should not include tumours, which, although congenital, are unconnected with defective closure of the vertebral arches.

Symptoms.—The tumour may be mainly cystic, smooth, and rather tense, or corrugated and shrunken, its integuments being coarse and sometimes hairy; it lies in the middle line, is closely attached to the subjacent bone, and is commonest in the lumbar or sacral regions. The diagnosis, from certain other cystic congenital tumours, is extremely difficult, if not impossible, in the absence of a history of previous spina bifida, and especially if no cleft in the spine is perceptible. Other congenital tumours are, however, rarely quite median in position, and are often multilocular.

The only rational *treatment* is extirpation, but this should not be undertaken without definite cause, *e.g.* increase in size, irritation, inflammation, or threatened suppuration; for although there may be no apparent connection with the spinal membranes, nerve elements may exist in the sac, interference with which may be disastrous. Moreover, the tumour if left untouched rarely gives trouble, and its removal can rarely be justified upon purely æsthetic grounds. Tapping, injection, and other methods have given no satisfactory results.

Congenital sacro-coccygeal tumours.—These tumours consist of two main classes. Class I. including attached fœtus, and fœtal inclusions, *i.e.* tumours containing fœtal remains, may be termed *parasitic*. Class II. (*non-parasitic*) includes dermoids; cystic tumours other than dermoids; fatty, fibrous, and fibro-cellular tumours and caudal excrescences.

Class I. **Parasitic. Attached fœtus.**—The most simple form is the so-called human tripodism, in which a third limb, usually formed of two extremities blended, is attached to the sacral region; the parasite being well developed or shrunken and deformed. One of

the normally placed limbs may be wasted and imperfect, whilst the parasite may be fully matured. From this simple form various grades of parasitic attachments are seen, ranging from irregular masses, from which project ill-defined limbs, to the most perfect forms of joined twins.

The *fetal inclusions or tumours enclosing fetal remains* are usually smooth, rounded, more or less pedunculated, and hang from the sacral region. They are cyst-like in form, their contents being clear fluid, with irregular masses of tissue in which fetal remains are found, such as ill-developed fingers, masses of bone, cartilage, muscle, and even intestine.



Fig. 602.—Congenital Sacro-coccygeal Tumour.

Occupying a position midway between the typical attached foetus and foetal inclusions is a form of attached foetus, which exists at birth as a rounded tumour, the wall of which subsequently gives way, limbs, etc., protruding. The subjects of parasitic tumours are generally born dead; of the remainder, few survive many days.

Class II. **Non-parasitic.**

—The *cystic tumours* are the commonest, and may be single cysts, or more commonly multilocular growths. The single cysts are principally instances of sacral spina bifida true and false, or ordinary dermoids. The multilocular tumours vary greatly in size, shape, and consistence. In all cases they

tend to increase rapidly, and may reach huge dimensions. Their attachments are very deep, and almost invariably come from the anterior aspect of the sacrum or coccyx, very rarely from the posterior surface. The mass is pendulous, pedunculated, and covered with thin skin, in which course immense thin-walled veins (Fig. 602). Very rarely is there any communication with the spinal canal. The pelvis may be distorted or ill-developed, especially if the tumour is not pedunculated.

Fatty, fibrous, and fibro-cellular tumours are rare: they are usually deep in origin, but may be superficial; fatty growths sometimes reach a very large size, filling the whole pelvis.

Caudal excrescences may be due to accessory coccygeal vertebrae, but are generally only pendulous masses of fatty or fibro-cellular tissue, containing no bone, which hang tail-like from the coccygeal

region; they rarely exceed two inches in length, and have no connection with the spinal canal.

Treatment.—The whole treatment of these tumours and excrescences may be summed up in the word "removal." Parasitic limbs may be amputated; tumours, including foetal remains, should be dissected away, care being taken to ascertain, as far as possible, that no communication exists with the spinal canal, and that in the larger masses no inseparable pelvic connection is present.

Single cysts, dermoid or otherwise, should be removed by the knife, and not treated by injection. The removal of multilocular cystic tumours, and of fatty or fibro-cellular masses, is often difficult, and sometimes necessarily incomplete, in consequence of the depth of the attachments in the pelvis. Removal should be attempted as early as possible, because of the tendency to rapid growth. Deliberate attempts at partial removal should be avoided.

Tumours of the spinal column.—These are identical in character with those affecting similar bony structures in other parts of the body. The *non-malignant* tumours are osteoma, chondroma, hydatids, and myxoma. The *malignant* are carcinoma, sarcoma (Fig. 603), and epithelioma. Malignant growths are commoner than benign, and affect females more often than males. They are rarely seen before middle life, and are commonest between forty and fifty years of age. The dorsal region is the usual site; rarely the lumbar or cervical regions are affected. The sarcomatous growths may be primary, but the carcinomatous growths are always secondary to disease in other parts, notably the breast. Sometimes they invade the spine from other parts. Thus, for example, epithelioma of the rectum may extend to the sacrum. Both primary and secondary growths usually begin in the bodies of the vertebrae, extending to the other parts of the bone and adjacent soft tissues. Growing into the spinal canal, they may compress the cord, but never infiltrate it.

No special causes for these growths can be assigned other than



Fig. 603.—Sarcoma of the Vertebral Column.
(St. George's Hospital Museum.)

injury and hereditary tendency, excepting in cases where the disease is clearly secondary to cancer of other parts.

Symptoms and diagnosis.—The early symptoms are very obscure. Constant fixed aching pain over the spine, much increased by movement, is usually the first sign. Slight rigidity, and perhaps some deep tenderness, may also exist. At this stage diagnosis is hardly possible, unless malignant growths exist elsewhere, or when there is evidence of the previous removal of a cancerous growth from some other part of the body. As the disease advances, persistent neuralgia, with or without anæsthesia of one nerve or set of nerves,

especially if bilateral, facilitates the diagnosis, which is rendered certain by signs of pressure on the spinal cord, or the growth of a manifest tumour about the column, behind or in front, especially in the thorax or abdomen. Angular curvature (Fig. 604), from the falling in of the softened bones, may occur, and in the absence of tumour may be mistaken for Pott's disease. Deformity from growth is soon followed by obvious signs of tumour. The tenderness is less than in Pott's disease, the pain on movement is greater, and the nerve pains are more intense. In the absence of deformity or tumour the age of the patient is a valuable guide. Cases in early life are almost certain to be caries, a history of tubercle generally negatives



Fig. 604.—Angular Curvature the Result of Sarcoma of the Spinal Column. (St. George's Hospital Museum.)

cancer, as does acute inflammatory tenderness or abscess, except in very rare cases. The symptoms due to erosion of the spine by aneurysm are indistinguishable from those of early malignant disease, if no characteristic tumour be present in either case.

Syphilitic gummata may resemble growths. The absence of pain and tenderness, and the presence of a history of syphilis, are the diagnostic signs. Neuritis, gouty or rheumatic, and intercostal neuralgia, may resemble the nerve pain of malignant disease.

Benign tumours.—*Osteomata* and *chondromata* are not uncommon about the root of the neck, and may cause neuralgia from irritation of the roots of the brachial plexus. They spring mostly from the transverse processes, and may be confounded with supernumerary ribs. They also occur in the lumbar region, and very rarely in the dorsal. *Osteomata* may in rare cases grow from the vertebral bodies

into the spinal canal, causing all the symptoms produced by a growth between the bone and dura mater. Osteomata or chondromata in other parts of the body, when associated with symptoms of cord pressure, are valuable indications.

Hydatids.—Echinococci may develop in the vertebræ, commencing generally in the bodies, and subsequently expanding other parts of the bone (Fig. 605). When the spinal canal is encroached upon, the symptoms are identical with those of extra-dural growths, and pressure on the cord follows. Diagnosis from other tumours is impossible unless the cyst appears in the soft parts, when a puncture with an exploring trochar will remove any doubt which may exist as to its nature.

Prognosis.—Malignant tumours are necessarily fatal. In benign growths the prognosis depends upon their relation to the spinal cord and their accessibility to surgical treatment. All tumours pressing on the cord, if allowed to take their natural course, end in death. Those which grow slowly like exostosis produce gradually-increasing symptoms. Hydatids terminate fatally, unless extirpated early by operation, generally from sudden paraplegia and rapid ascending cord changes, following upon bursting of the cyst.

Treatment.—Malignant growths, even when primary, can hardly be within the limits of justifiable surgical interference. The treatment, therefore, must be directed to the relief of pain and to the management of incidental symptoms as they arise. In benign tumours pressing on the cord, the only hope lies in removal. In all cases, therefore, when the symptoms are sufficiently suggestive, an exploratory operation should be performed with a view to extirpation. Hydatid cysts showing themselves at the back should be laid open and treated upon the same principles as elsewhere; if such radical proceedings are deemed unwise, drawing off the fluid from the cyst through a fine trochar may diminish the chances of spontaneous rupture into the canal.

Caries and necrosis.—Caries, or Pott's disease, is the commonest and, therefore, the most important surgical disease of the spine. In childhood the two sexes are affected equally; after puberty, males, in consequence of their greater liability to injury, suffer more than females. It is most frequent in childhood between



Fig. 605.—Hydatid of Spine. (St. George's Hospital Museum.)

the ages of three and twelve; it may exist at birth, and has been seen in the foetus in utero. As age advances caries of the spine decreases in frequency. After forty or forty-five it is more common than any other primary tubercular affection.

Ætiology.—The disease is essentially tuberculous. It is doubtful whether it occurs in healthy subjects free from tubercular tendency. Injury direct, as from a blow, or indirect, as from a strain of ligaments, etc., especially the intervertebral disc, is a potent factor in lighting up the disease. It may be caused by extension of inflammation from contiguous parts. In many cases no exciting cause can be made out. The disease is met with in every class of life, but is comparatively rare in the well-to-do; increasing in frequency, *ceteris paribus*, in direct ratio to deficient or improper feeding, and defective sanitary surroundings, it is commonest among the poverty-stricken and crowded inhabitants of large towns.



Fig. 606.—Anterior Parts of the Bodies of the last Dorsal and first Lumbar Vertebrae affected by Caries. There is no deformity, and the intervertebral disc is intact. (St. George's Hospital Museum.)

The dorsal spine is most commonly affected (50 per cent. of cases), then the lumbar (30 per cent.), the cervical and dorso-lumbar being nearly equally concerned (10 per cent. each).

Atlo-axoid disease occupies a place by itself, and is seen in only about 1 per cent. of the total number of cases. Very rarely are two distinct parts of the spine affected separately at the same time.

Pathology.—The carious process is identical with that occurring in other similar structures. It may begin primarily in the centre of the body of the vertebra or on its anterior or posterior surface (Fig. 608) (much more often the former), the commonest situation of all being the point of junction of the intervertebral disc with the body. The disc is usually disintegrated at the same time as the bone, but sometimes remains intact although the vertebral body above and below may be completely destroyed (Fig. 606); on the other hand, the disc may be entirely destroyed, the adjacent bones being left intact, or nearly so (Fig. 607). In some cases the caries is secondary to tuberculous disease of the intervertebral synovial joints. As a result of the destructive process, the bodies of the affected bones soften and break down; finally, the parts above and below fall together, mainly from loss of support, the result being a bending forward of the spine above and below the diseased part, and a backward projection of one or more spinous processes, producing

the characteristic deformity known as *angular curvature*, which may be so slight as to be hardly noticeable, or may form a huge hump, involving many vertebræ. The degree of deformity depends to some extent upon the amount of disease, especially upon its depth; extensive superficial destruction of the anterior surfaces of the bodies of the vertebræ may take place without distortion. Lateral deformity is rarely seen without angular curvature. The destructive process may be merely a gradual softening or melting away of the bone, or may be more gross, masses of carious or necrosed bone being thrown off. Inflammatory products, pus and bone *débris* may collect either in the vertebral canal or external to it, or in both these situations, separately or in continuity. The spinal cord may be compressed or affected by inflammation, chronic or acute. Compression, if it occurs, is not, as a rule, due to bone pressure, but to inflammatory effusion between the dura mater and the bone; sometimes it is caused conjointly by displaced bone and inflammatory products. The nerves leaving the intervertebral foramina in the diseased area are often involved in the inflammation.

The **symptoms** of caries of the spine are: (1) Rigidity; (2) tenderness; (3) local pain; (4) deformity; (5) abscess; (6) evidence of implication of nerves and spinal cord.

Rigidity due to absence of movement in the intervertebral joints may affect two vertebræ only, or many; it is the most constant of all symptoms; nevertheless, in rare instances, caries or necrosis if limited to one vertebral body may be unassociated with rigidity, although a large psoas abscess may have formed. At first the rigidity is caused by protective muscular action; later, by ankylosis; prior to ankylosis it is invariably accompanied by *tenderness*, which is also an early symptom, the accidental discovery of which often leads to the detection of caries; it may be elicited by direct pressure upon the spinous processes, or by percussion on the head or shoulders. *Pain confined to the seat of disease* is a very uncertain symptom; many cases are painless throughout, although pain can usually be produced by rough manipulation or exercise; local pain is never felt *above* the seat of lesion.

The period at which *deformity* or *angular curvature* occurs

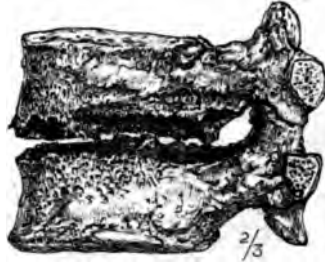


Fig. 607.—Two Lumbar Vertebræ; the intervertebral disc has been completely destroyed by ulceration, the bones being only very slightly affected: for comparison with Fig. 606. (St. George's Hospital Museum.)

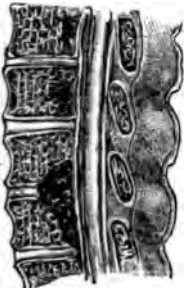


Fig. 608.—Caries of the Posterior Aspect of the Bodies of the Vertebræ.

varies greatly. In painless cases it may be the first symptom noticed; sometimes the disease exists for many years without this symptom, but as a rule it shows itself within eighteen months. Speaking generally, it occurs earliest in disease of the dorsal spine where, for obvious mechanical reasons, it also reaches its most

exaggerated form. In the neck, although deformity from general thickening is common, angular curvature is unusual, excepting at the junction of the cervical and dorsal regions, where it sometimes is seen in a marked degree, the whole neck bending forwards, so that the face looks directly downwards. The deformity may be gradual or rapid in growth, or after injury in old cases of caries may be sudden, in which case paraplegia, as a rule, coincides. Although deformity usually develops at some period of Pott's disease, its absence in no way negatives the existence of caries if other symptoms are present (Figs. 609 and 610).

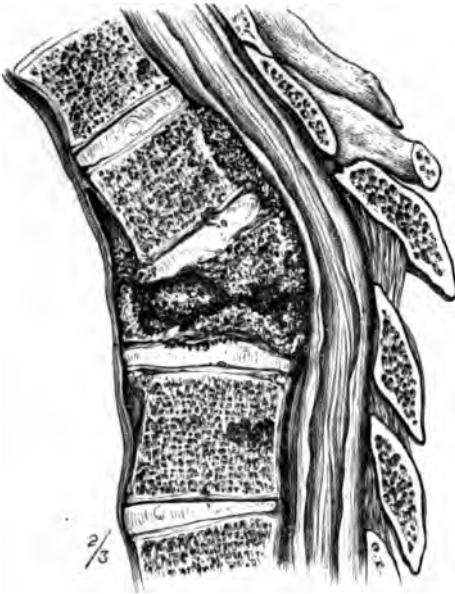


Fig. 609. — Angular Deformity in Caries. Vertical section through the affected portions of the column and spinal cord. (St. George's Hospital Museum.)

Abscess probably develops in all cases, al-

though it may not become obvious in consequence of its small size, or because its contents, becoming inspissated, dry up. It may appear early or late; sometimes it is the first symptom complained of. The course the pus takes is mainly determined by the direction of the fascial planes and by gravitation; very rarely an abscess will travel upwards, *e.g.* from the dorsal region to the neck.

Abscess in connection with disease of the cervical spine may come to the surface, either at the back or side of the neck, or may pass forwards and present at the back of the pharynx (retropharyngeal abscess), especially in cases of atlo-axoid disease (Fig. 612). In disease of the lower cervical spine it may descend into the posterior mediastinum, and may open into the gullet, trachea, lung, or pleura. In dorsal disease the abscess may come to the surface immediately over the diseased part, may make its way into the pleura or lung, may pass to the loin, or run down to the thigh in the sheath of the

psoas muscle; it may extend into the gluteal region, iliac fossa, or even into the perinæum.

In lumbar disease the abscess may pass into the loin, iliac fossa, or ischio-rectal region; it may burrow around the kidney or open into the bladder or rectum. The only variety requiring special notice is *psoas abscess*, so-called because it passes down to the sheath of the psoas muscle. Commencing in the dorsal region, it enters the psoas sheath by going through or under the diaphragm; generally destroying the psoas muscle in its progress; it reaches Poupart's ligament, and enters the thigh to the outer side of the femoral vessels, where it presents itself as a fluctuating swelling, with distinct impulse on coughing; it may then travel to any part of the thigh, and, guided by the fascial planes, may pass to the popliteal space, or even to the side of the ankle. It may leave the psoas sheath above Poupart's ligament, losing its typical character, and pass to the loin or one of the various situations already indicated. Appearing sometimes at the inner side of the femoral vessels, it may simulate hernia or saphenous varix, from each of which, however, it is always distinguishable by the fluctuation felt between its crural and abdominal portions.

Carious or necrosed bone may be found in any of these spinal abscesses; the odontoid process, and a great part of the atlas may be thrown off from retro-pharyngeal abscess, and masses of dead bone



Fig. 610.—Exaggerated Deformity after extensive Destruction by Caries of the eight lower Dorsal and first Lumbar Vertebrae, the remains of which are fused into a solid column 3 inches long. The deformity is so great that the body of the fourth dorsal vertebra is within three-quarters of an inch of that of the second lumbar. (St. George's Hospital Museum.)

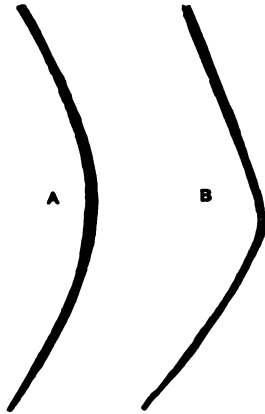


Fig. 611.—Diagram showing (A) the true Bow of the Rickety Spine and (B) the broken Curve of Caries.

the commonest sign of implication of the spinal cord; it may occur early or late, and often first appears after rapid change in the deformity. The degree of paralysis, as a rule, bears no relation to the amount of angular curvature. In cases of deformity, in which paraplegia has existed for some time, increase of the curvature may be followed by decrease in the paralysis. Palsy often appears after slight injury in caries of long standing, and in painless cases may thus be the first symptom of which complaint is made. The paralysis is rarely sudden, but may be complete in a few hours: generally, weeks, months, or even years pass before it is complete. Wasting of muscles follows. The palsy may be spastic if the disease is above the lumbar enlargement. Convulsive movements in the paralysed parts may occur before the muscles have wasted. The sphincters are usually paralysed, but may escape.

have been expectorated from the lung; spinal sequestra have formed the nuclei of vesical calculi, and have been extracted from recto-vesical abscesses or passed per anum.

The symptoms arising from implication of the *nerve roots or nerves* passing from the affected region in caries, vary considerably. Acute pain on both sides of the body, following the motor nerves from the seat of disease, is a characteristic symptom, which may or may not be present as the so-called "girdle pain"; there may be corresponding hyperæsthesia or anæsthesia. Often there is muscular weakness, especially when the disease involves the lower cervical region. Herpes may occur along the affected nerve areas. The reflexes are modified or absent.

Paralysis below the seat of lesion is

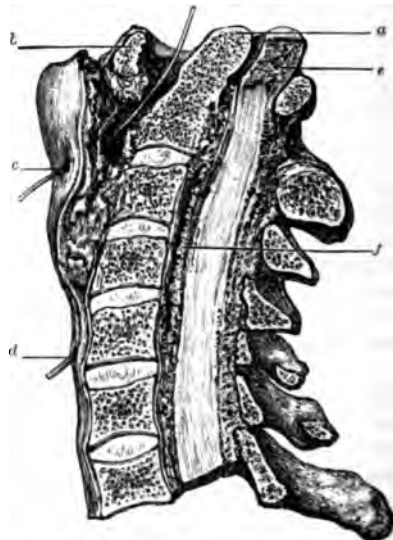


Fig. 612.—Atlo-axoid Disease with Subluxation. (St. Mary's Hospital Museum.)

a, Odontoid process; b, anterior arch of atlas; c, opening of the retro-pharyngeal abscess; d, opening of abscess connected with 3rd, 4th, 5th vertebra; e, cord disorganised by pressure and inflammation; f, spinal canal, showing extension of the disease downward. Lymph on both surfaces of dura mater. (Pepper.)

Excepting a few rare cases, to which reference has been already made, in which the disease is so limited that no rigidity is produced, the *gait and attitude* in caries are unmistakable. Every movement of the trunk is made with caution, especially in upper cervical disease, and there is an appearance of general stiffness of the body; all suppleness is lost, the change from the sitting to the erect position is effected by pushing the trunk upwards by means of the hands placed upon the knees. In picking up an object from the floor, the disengaged hand is placed upon the knee, serving to steady the trunk on stooping, and to push it up in regaining the erect position. When deformity exists, the trunk appears short, the arms unduly long and ape-like; in dorsal disease the shoulders are very square and raised, so that the head and neck seem to sink between them, and "pigeon breast" is necessarily present. The *maintenance of the upright position* in angular curvature depends upon the formation of compensatory curves in the column. If, as occasionally happens in lower cervical and lumbar disease, the secondary curves do not follow, the deformity caused by the falling forward of the column above the lesion is most distressing, especially in lumbar caries, in which progression, in the absence of compensatory curves, is only possible by crawling on the hands and feet.

Diagnosis. — In well-marked cases the diagnosis is easy, especially if deformity or signs of cord implication are present. Angular curvature caused by *malignant disease* of the column (page 272) and hydatids must be borne in mind. From the *rickety spine* of infants caries is distinguished by the absence of true rigidity in the rickety spine, which completely straightens when the child is placed on its face, or if it is raised from the bed by the hand placed under its back; moreover, the rickety curve is a true bow; the distortion of caries is not (Fig. 611, and p. 368, Vol. I.). Rigidity from *erosion by aneurysm* in the early stage is indistinguishable from that of caries in the absence of characteristic tumour. The diagnosis from "*hysterical spine*" in early cases is sometimes extremely difficult. The sex and aspect of the patient, the absence of true rigidity, the excessive but vague local pain, the cutaneous hyperæsthesia, the absence of well-defined local tenderness, and the uninterrupted suppleness in movement, are usually sufficient to indicate the hysterical condition. In *lumbago and rheumatism* the stiffness is rather a jerky restrained movement than true rigidity, and tenderness, when present, is over the muscles rather than over the bones. The cyphotie rigidity of *old age*, *congenital stiffness* of the lumbar spine, and the rigidity of *spondylitis deformans* (page 285), should not mislead, as no other symptom of caries is present. Stiffness of the hip joint, due to contraction of the psoas muscle, differs from the rigidity of *hip disease* in causing the pelvis to move with the thigh in extension only, flexion being normal. Spinal abscesses burrowing about the hip may closely simulate hip disease, and cause stiffness from general infiltration of the soft parts. All abscesses or sinuses of obscure nature about the back, hip, or buttock should

lead to careful search for spinal disease. Caries of the spine in infants and young children, with loss of power in the lower limbs, has been mistaken for *infantile paralysis*.

Prognosis.—The progress of caries of the spine is, as a rule, slow; the disease may terminate in three months or may continue for years, the average time being about three and a half years before

recovery or death. Recovery is commoner in children than adults, and is naturally more probable in the strong and well nourished than in the feeble and badly fed. The sooner proper treatment is adopted after the onset of the disease the better are the chances of cure, although in many cases the tendency to recovery is so great that ankylosis follows without previous methodical treatment (Fig. 618). The occurrence of abscess is an unfavourable sign; *cæteris paribus*, the nearer the point at which the abscess becomes superficial is to the seat of disease the better is the outlook.

Recovery is due to ankylosis with or without the formation of abscess. The causes of death are—(1) abscess, causing hectic, pyæmia, marasmus, or lardaceous disease; (2) acute inflammation or chronic changes in the spinal cord; (3) rapid falling away after the opening or bursting of



Fig. 613.—Suspension Apparatus for use in the Application of plaster of Paris, or silicate of potash, spinal bandage.

abscess; (4) hæmorrhage into the abscess sac from communication with some large vessel, *e.g.* the thoracic aorta; (5) suffocation from bursting of abscess into the lung or air passages; (6) sudden dislocation of the odontoid process, from softening of its ligamentous connections.

Treatment.—The sole object in the treatment of caries of the spine is to afford *rest* to the diseased parts, which can only be efficiently done by keeping the patient perfectly flat in the recumbent position for a long period. In the neck, where the tendency to lateral



Fig. 614.—Showing mode of Application of Leather Spinal Splint in Cervical or Cervico-dorsal Disease. (From a photograph.)

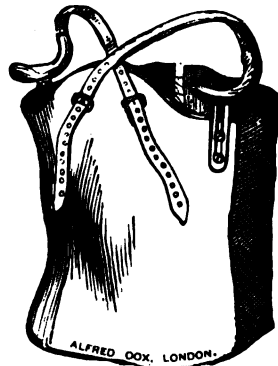


Fig. 616.—Leather Splint, with axillary Crutches for Caries in dorsal and dorso-lumbar regions.



Fig. 615.—Spratt's Leather Splint for Cervical Caries, with occipital support and chin rest.



Fig. 617.—Leather Splint with Jury-mast sometimes used for support of the Head in Disease of the Cervical Spine.

movement is great, the head should be steadied by sand-bags placed on each side, which are far better than any of the more elaborate



Fig. 618. — Case of extensive Caries of the Spine in which Anchylosis followed, although no methodical treatment of any kind had been adopted. (From a photograph.)

contrivances often used for the purpose. Pulley extension (Fig. 591) is also useful for the relief of pain as well as for the *prevention of deformity*. If deformity is already present with sores or abscess immediately about it, the prone position may sometimes be useful for the removal of pressure and the better application of dressings, but in a general way the recumbent position is best. The period for rest varies in different cases, and depends upon the progress of the case; rarely is anything less than a year sufficient, and two, three, or more years may be necessary. Speaking generally, the rest should be maintained until ankylosis has occurred, or, at least, until all active local symptoms have subsided. By this treatment the prospect of cure is greatest, and the chances of deformity are least. Deformity may, however, come on during the recumbent treatment, even when adopted at an early stage of the disease, as ankylosis, being a necessary part of the cure, can only occur after the parts above and below the disease have come together, a process which is partly due to the reflex contraction of the abdominal muscles, and partly to the shrinking of the healing medium between the bones. No rigid bandage, splint, or mechanical contrivance can supply the place of rest of the kind indicated; these means, therefore, should only be adopted when absolute rest is no longer necessary, *i.e.* when ankylosis has occurred, all active symptoms having subsided; or if the health is failing from the restraint which rest involves, especially when abscesses are discharging. Exception to the rule with regard to rest in the recumbent position, must be taken in the case of infants and young children, in whom the maintenance of the flat position is often impossible; the rigid bandage or splint then affords

the only prospect of obtaining anything like efficient rest. The rigid bandages are the plaster of Paris, the silicate of potash, and the starch; the second is the best (Fig. 613). The splints are the poroplastic and

the leather; they are preferable to the rigid bandages, as they can be removed at intervals for purposes of cleanliness. The leather splint is by far the best; it is easily moulded, it is more durable, and if metal crutches or supports are necessary affords a firmer basis for their attachments than the poroplastic felt (Figs. 614, 615, 616). In the application of all these contrivances the main object in view is to take the superincumbent weight off the diseased part, which may be done by direct support in cervical, dorsal and lumbar disease, or, less effectually, by suspension of the head from a jury-mast (Fig. 617) when the disease involves the cervical spine only; hence care must be taken to obtain a good bearing from the shoulder in cervical disease and from the pelvis in disease lower down. Suspension of the patient for the application of bandages is unnecessary, and forcible extension or straightening of the spine to rectify deformity purely the result of a reparative process, is dangerous and unreasonable. In moving the patient for nursing purposes in caries, the greatest gentleness should be used, especially in upper cervical disease, in consequence of the liability to sudden death from displacement of the odontoid process.

Abscesses, when manifest, should be opened early. Retro-pharyngeal abscess, unless pointing clearly in the neck, should be incised through the mouth, the patient being placed on the side. Dorsal and lumbar abscesses should be laid freely open, their walls scraped, the diseased bone examined and, if possible, removed in the manner recommended by Treves (Fig. 620).

Psoas abscess should be freely opened at its most superficial part, scraped, the cavity treated with some germicide, and the incision closed (*see* p. 96, Vol. I.); when drainage is required it should be effected through the loin. In the majority of cases the treatment is conducted on the same lines as that of tuberculous trouble elsewhere. (*See* p. 539, Vol. I.)

Sinuses discharging on the anterior aspect of the body may often be made to heal, when the original disease has become quiescent, by keeping the patient continually in the prone position, for purposes of better drainage. In all cases after apparent cure, a leather or poroplastic jacket should be worn for at least three years, especially in growing subjects. Progressive or stationary *paraplegia*, presumably due to pressure and not to secondary changes in the cord, should be treated by laminectomy.

Necrosis.—Apart from caries, necrosis is uncommon. It may,



Fig. 619.—Necrosis of the Body of a Vertebra. (St. George's Hospital Museum.)

however, be caused by injury, gunshot and other wounds, or fracture; it occurs in syphilis, when it may be central in the body of the vertebra (Fig. 619). In young subjects, presumably tuberculous,

a necrosed spinous or transverse process is sometimes found in superficial abscesses of the back.

Intervertebral arthritis.—Two distinct pathological conditions are included in this term, namely, disease (1) of the synovial intervertebral joints, and (2) of the intervertebral discs.

The diseases of the synovial articulations are the same as those of other similar joints, namely, synovitis from injury, rheumatism and syphilis; pyæmia; and tuberculous disease, which may occur primarily or may be secondary to Pott's disease. In traumatic and pyæmic cases, abscess may cause death by bursting into the spinal canal; in pulpy disease, necrosed articular surfaces may be discharged from abscesses.

The **symptoms** of synovial intervertebral arthritis are too vague for precise description: the history of the case, rigidity, and pain, *especially on rotation*, are the main symptoms, and these are often indistinguishable from the early stage of caries. Disease of the intervertebral discs is, for clinical purposes, inseparable from caries of the bones; abscess in the vertebral bodies may cause death by perforating the disc and opening into the spinal canal; primary abscess of the disc has been described.

Spondylitis deformans.—This must be regarded as synonymous with osteoarthritis. In common with the affection in other parts of the body, it is most frequently seen in late middle life, and

old age; it is, however, not infrequent at any time after twenty-five years of age, and it has been seen in children. Males suffer more often than females. A rheumatic history generally exists, and

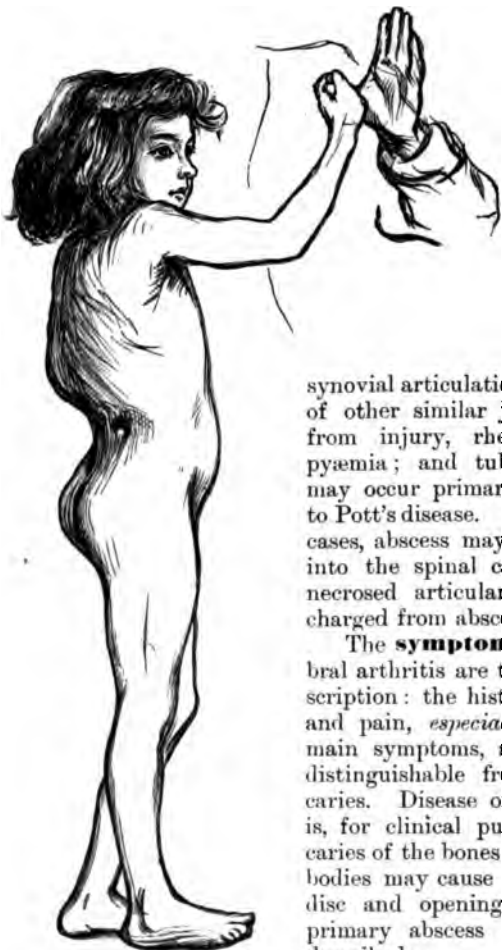


Fig. 620. — Case of Recovery from extensive Caries with Lumbar Abscess which was treated by free incision, scraping, and removal of a mass of diseased bone. (From a photograph.)

occupations which involve much stooping or the carrying of heavy weights on the head or shoulders appear to be predisposing. Like all rheumatic conditions, it is intensified by cold and wet. The regions most commonly affected are the dorsal and lumbar, then the upper cervical.

The **pathology** may be concisely described as absorption of the inter-vertebral discs, and the formation of lateral bony outgrowths from the vertebral bodies generally extending from the sides of the anterior common ligament to the bases of the transverse processes (Fig. 621); the union of these bony outgrowths, which are usually symmetrical, across the disc causes complete ankylosis. The discs are replaced more or less completely by bone, in some cases without any formation of lateral osteophytic masses (Fig. 622). In the synovial inter-articular and costo-vertebral joints, eburnation and the other changes peculiar to osteo-arthritis take place. The column becoming stiff, the unused muscles naturally waste.



Fig. 621.—Spondylitis Deformans; five dorsal vertebrae united by lateral masses of new bone. (St. George's Hospital Museum.)

'rheumatic' aching, change in gait, rigid cyphosis, and stooping, a peculiar poking forwards of the chin occurring when the neck is affected (Fig. 623); lateral movement is greatly constricted and sometimes grating is felt. Osteo-arthritis in other joints commonly co-exists. The breathing may be short and laboured, from the stiffening of the costo-vertebral joints; in some cases these joints become ankylosed, the breathing then being entirely diaphragmatic. Nerve pains and perhaps local palsies may result from



Fig. 622.—Complete Ankylosis of two Vertebrae in a Patient affected with Osteo-arthritis. (St. George's Hospital Museum.)

pressure at the intervertebral foramina. In rare cases secondary changes in the cord follow. In young subjects the disease may shorten life.

No **treatment** other than that applicable to osteo-arthritis generally can be suggested; in young subjects the acute pain of the early stage can be greatly relieved by the actual cautery freely applied over the spinal column.

Coccydynia.—This term is applied to the persistent pain and tenderness which sometimes follow stretching or laceration of the fibrous tissues about the coccyx by falls or blows. It is commonest in women, especially in those of a hysterical temperament. The symptoms are acute tenderness over the coccyx, and intense radiating pain which is started by the slightest touch on the coccygeal region; the pressure produced by sitting in an ordinary chair is intolerable, and any strain on the part, such as that caused by rising from the sitting to the erect position, or by defæcation, causes intense suffering. In extreme cases, the general health may rapidly fail from the combined effects of pain, restlessness, and anxiety. Constipation is a fruitful cause of perpetuating the symptoms.

Pathologically, the main lesion appears to be neuritis secondary to traumatism.

The diagnosis is easy, and generally unmistakable; but the existence of anal fissure, piles, and uterine derangements should not be lost sight of, as they may give rise to somewhat similar symptoms.

Hysterical subjects should be treated on recognised principles, aided locally by the actual cautery



Fig. 623.—Spondylitis Deformans, showing the attitude and general aspect of the patient. (From a photograph of a patient of Mr. Clutton's.)

or blisters over the lower sacral region. In ordinary cases, removal of pressure by properly adjusted cushions or pads generally effects a cure. In obstinate cases the fibrous connections of the coccyx may be divided or the bone removed.

Tumours of the spinal cord. Varieties.—These may be

- (1) *Extra-dural*, i.e. between the dura mater and the bone, growing from the tissues between the bone and dura mater (lipoma, hydatids, and sarcoma), (b) from the bones themselves (osteoma, chondroma, hydatids, sarcoma, and secondary growths of cancer), or standing into the canal through the vertebral foramina (chondroma, sarcoma, osteoma); (2) *intradural*, i.e. between the dura mater and the cord, which grow from the inner surface of the dura (Fig. 623), or from the arachnoid, or pia mater (gumma, tubercle, hydatids, lipoma, the last associated with spinal meningitis); (3) *intra-spinal*, i.e. in the cord, growing from the cord itself or from the arachnoid, or pia mater (gumma, glioma, sarcoma, tubercle).

Extra-dural tumours may develop inside the canal, especially in the cauda equina, from old hæmorrhages, or as the result of organised products in caries, are not between the dura and the bones.

Extra-dural tumours are generally single, but the latter may be multiple or diffuse. Neuromata and sarcomata are usually multiple. Tumours of the cord itself are nearly always single. Intra-dural growths cause more compression of the cord than the extra-dural. The degree of compression depends upon the site, size, and consistence of the tumour; *ceteris paribus*, the larger the canal as compared with the cord the less the compression. The effect upon the cord varies from a slight pitting to reduction to the size of a crowquill, or even to apparent interruption of continuity, the connections between the upper and lower portions being merely fibrous.

Symptoms.—The most marked and earliest of the symptoms is *pain*—sharp, dull, burning, or wrenching—in the nerves coming from the seat of the tumour, which is more or less paroxysmal, with intervals of partial but never complete relief. At first the pain is usually limited to one side, but soon involves both. It may be increased by movement, especially in extra-dural tumours, in which local pain, and possibly tenderness and rigidity, may also develop. With the pain there occurs *modification of sensation*—e.g. formication.



Fig. 624.—Tumour growing from the inner surface of the Dura Mater between the sixth and seventh Cervical Nerves. (St. George's Hospital Museum.)

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Neuromata may develop inside the canal on the nerve roots, especially in the cauda equina. Blood cysts from old hæmorrhages, and fibrous masses the result of organised inflammatory products in caries, are not uncommon between the dura and the bones. Extra- and intra-dural tumours are generally single, but the latter may be multiple or diffuse. Neuromata and sarcomata are usually multiple. Tumours of the cord itself are nearly always single. Intra-dural growths cause more compression of the cord than the extra-dural. The degree of compression depends upon the site, size, and consistence of the tumour; *cæteris paribus*, the larger the canal as compared with the cord the less the compression. The effect upon the cord varies from a slight pitting to reduction to the size of a crowquill, or even to apparent interruption of continuity, the connections between the upper and lower portions being merely fibrous.

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Fig. 624.—Tumour growing from the inner surface of the Dura Mater between the sixth and seventh Cervical Nerves. (St. George's Hospital Museum.)

tingling, numbness, and perhaps a feeling of tightness around the body. *Muscular spasm* is usual in growths springing from the membranes, and the limbs supplied from the affected region and below it may become contracted.

Gradual paralysis of the parts below the lesion is constant, commencing generally on one side only, and affecting the proximal parts of the limbs first. Rapid palsy may occur at any time from acute myelitis.

Loss of sensation corresponding to the motor paralysis follows when the tumour is below the dorsal region. If the lesion is higher up, the anæsthesia is sometimes greatest on the side opposite to the paralysis. Loss of sensation, apart from that due to the lesion in the cord itself, may be caused by the nerves being involved. In multiple growths, and those affecting the posterior columns, inco-ordination may occur. Speaking generally, the reflexes are lost if the growth involves the lumbar enlargement, or the parts below it, and increased (with coincident cutaneous hyperæsthesia) when the lesion is higher up.

Muscular contractions are common, and wasting follows in the parts supplied by the affected nerve roots. Flushing of the skin, "tache spinale," and other signs of *vaso-motor disturbance* are usual. Complete loss of control over the sphincters may or may not be present. Finally, bed-sores and other symptoms characteristic of extensive secondary changes in the cord develop.

Diagnosis.—The symptoms of tumours of the spinal cord resemble those caused by growths of the column, and by caries in the early stage prior to deformity. Growths of the column encroaching on the canal are indistinguishable with certainty from tumours of the spinal membranes before the development of manifest tumour about the bones, but intense pain on movement points to growths of the column rather than of the membranes. In caries the resemblance is greatest in extra-dural growths, and least in tumours of the cord, in consequence of the early occurrence of signs of cord irritation in the latter. The pain from irritation of the nerve roots is comparatively slight in caries, and paralysis is nearly always bilateral from the first, and not unilateral as is almost without exception the case in the early stages of tumours of the cord. Frequently it is only after the typical local signs of bone disease have developed in caries that the diagnosis between that condition and growth is possible.

Speaking generally, tumours in the cord cause much less radiating pain from irritation of the nerve roots than do tumours of the membranes, in which local pain, tenderness, and even slight rigidity may occur. The symptoms caused by growths in the membranes are more persistently unilateral. Pain in growths of the cauda equina may be mistaken for sciatica, but it is always bilateral, which sciatica very rarely is. The diagnosis of the exact nature of the growth is impossible, unless a clear syphilitic history exists. The co-existence of cancer, tubercle, or growths in other parts is suggestive. The commonest tumour is sarcoma; the rarest that resulting from tubercle.

Prognosis.—Although temporary improvement may occur, all spinal tumours, unless removed by operation, terminate in death, as a rule within three years, excepting the syphilitic, which may be completely or partially cured by treatment.

Treatment.—Symptoms pointing to the existence of growths inside the spinal canal should in the first instance be treated by mercury or iodide of potassium, whether a history of syphilis is obtainable or not, unless the co-existence of cancerous or other growths elsewhere points clearly to the nature of the case. If, at the end of a month, no improvement has followed, an exploratory operation is indicated. To delay operation longer is to make its chance of effecting good infinitesimal.

The operation of laminectomy.—In diseases of the spine this operation, which consists in the exposure of the interior of the spinal canal by removing one or more of the posterior vertebral arches, is exploratory or curative.

For *exploratory purposes* it is indicated when symptoms of pressure on the spinal cord from any cause are, although not sufficiently distinct to make a positive diagnosis possible, sufficiently suggestive to justify some risk being run, in order to ascertain their cause with a view to its removal.

As a *curative measure*, it is applicable in undoubted tumours inside the canal, and in progressive or stationary paraplegia in caries, presumably due to pressure and not to secondary changes in the cord. When symptoms of advanced changes in the cord from acute or chronic myelitis are present, laminectomy is useless and unjustifiable. The operation is in itself severe, and entails some immediate risk to life. It should, therefore, only be performed when the chances of good resulting are in excess of the risk to life involved in its performance.

Paracentesis of the spinal canal, by the introduction from behind of a fine trochar and cannula through one of the spaces between the laminae in the upper cervical or lumbar region, is said to have been practised with benefit in certain cases of meningitis, the object being the relief of abnormal tension by the withdrawal of cerebro-spinal fluid. The operation is by no means easy, in consequence of (1) the tendency of the cervical laminae to overlap one another, and (2) the depth at which the lumbar laminae lie from the surface.

XLI. DISEASES AND INJURIES OF THE EAR.

By A. MARMADUKE SHEILD, M.B. CANTAB., F.R.C.S.,

Assistant Surgeon to St. George's Hospital, and late Aural Surgeon to Charing Cross Hospital.

Examination of a case of deafness.—The first duty of the surgeon in examining a case of deafness is to form an estimate of the general *constitutional condition* of his patient. Is he an obvious sufferer from gout, tuberculosis, or inherited syphilis? Does he display the open mouth and vacuous expression of nasal obstruction, or the facial deformity of Bell's paralysis? The *history* and family history of the case will next be noted, and especial inquiries will be made into the duration of the deafness, its mode of onset, and the presence or absence of pain, discharge, or tinnitus.



Fig. 625. —
Large Tun-
ing Fork
for Testing
Hearing.

The *hearing* may next be conveniently *tested* by the tick of a watch approached gradually to the ear, and the result expressed in inches by a fraction, the numerator of which is the distance the watch is heard from the ear of the patient, the denominator the distance the watch is readily heard by a person of good hearing. Thus, a watch, the tick of which is heard at forty-eight inches by a patient of good hearing, is only heard at five inches from the ear of a deaf patient. This will be conveniently expressed by the fraction $\frac{5}{48}$. The expression $\frac{5}{48}$ indicates that the watch is heard on contact with the bones only, and $\frac{0}{48}$ would imply that the tick of a watch heard at 48 inches by a person of good hearing is not appreciated under any circumstances by the patient. Conversation may be carried on at different distances, the patient being not allowed to watch the lips of the surgeon. Hearing power differs so widely, that there is no satisfactory "standard test" that can be well employed. These methods, though rough, give good practical estimation of the hearing power. The various proceedings and apparatus employed for testing hearing are too numerous to describe in this Article.

Next estimate whether the *conducting media* or *perceptive apparatus* are at fault, by placing a large vibrating tuning-fork upon the forehead or teeth (Fig. 625). In the case of unilateral deafness, the fork will be heard loudest on the deaf side, if there be any affection of the conducting media, since the waves of sound are prevented from escaping externally, and are intensified and thrown back upon the perceptive apparatus. This may easily be verified by the student placing one finger in his ear, and a vibrating fork on his own forehead. In the case of bilateral deafness from affections of the middle or external ear, the fork is heard long and loud on the mastoids. The longer and louder the sounds of the fork are heard on the mastoid of a deaf ear, the greater reason there is to negative nerve deafness. If, in a case of unilateral deafness, the sounds of a fork placed upon

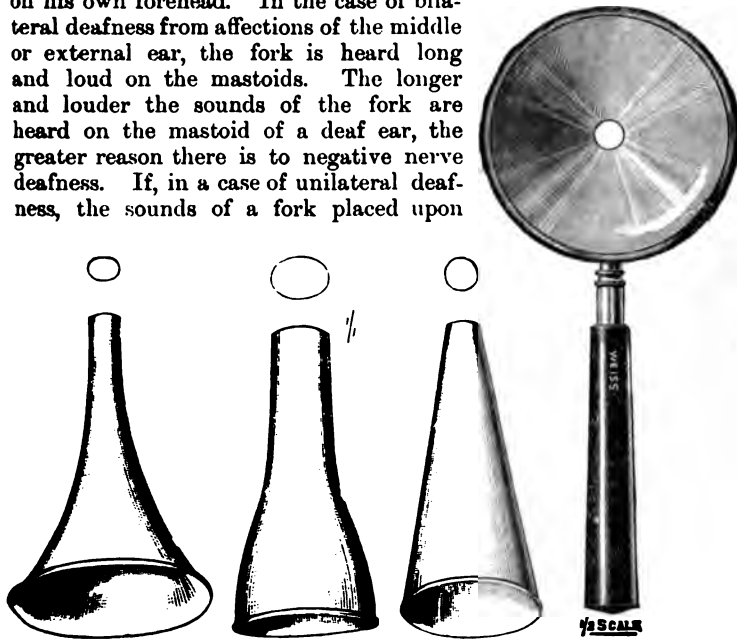


Fig. 626.—Hand Mirror and Specula.

the mastoid of the deaf ear soon cease, and the fork being then placed at the orifice of the canal, the sounds of it are again heard, this will show that aerial conduction predominates over bone conduction, and an affection of the nerve apparatus may be suspected. If, on the contrary, the fork is heard long and well through the bones, and not at all afterwards at the meatus, the nerve apparatus is healthy, and the conducting media are at fault. This is the essential of Rinne's test. The method is open to many objections in practice, and is quite useless unless one is dealing with intelligent persons. The patient lifts his finger the moment he ceases to hear the fork. The method of Gardiner-Brown is to place a large vibrating fork upon the mastoid. If the surgeon can feel the vibrations longer than the patient can hear them, nerve lesion is present. If the patient can hear the vibrations as

long as or longer than the surgeon can feel them, the affection is one of the external or middle ear. There are numerous modifications of these tests, and various formulæ to express them, but in practice we generally return to the consideration, that if a fork be well

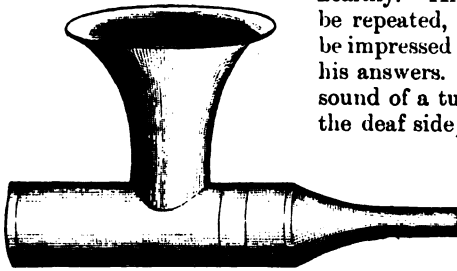


Fig. 627.—Brunton's Otoscope.

the bones, the nerve apparatus is healthy. All tuning-fork tests must be repeated, and great accuracy must be impressed upon the patient in giving his answers. Few are aware that the sound of a tuning-fork is heard best on the deaf side, if the tympanum or canal

is implicated. Consequently they generally deny appreciating the sounds of the fork, having already made up their minds that they cannot hear upon

the deaf side. Repetition of the experiment soon convinces them of their error. *Inspection of the auricle and canal* may be carried out before a bright light, by pulling the pinna upwards and backwards, and the tragus forwards. The nature and quality of any discharge is noted, the condition of the canal, and such conditions as exostosis, impacted foreign body, or polypus, will frequently be at once detected by this simple manœuvre.

The *mirror and speculum* are next employed (Fig. 626). Thorough illumination must be obtained with a hand or forehead mirror, from bright daylight, a powerful oil lamp, or electric light. Brunton's otoscope (Figs. 627, 628) may be employed. The aural speculum (Fig. 626), warmed and of appropriate size, is inserted and lightly held



Fig. 628.—Brunton's Otoscope in use.

between the thumb and index fingers of the left hand, the auricle being at the same time gently drawn upwards and backwards by the middle and index fingers. This manœuvre is a little difficult, and more will be learnt by a few practical lessons than by pages of instruction. Should the canal, as commonly happens, be obstructed by discharge, this should be gently washed away with the syringe, and the parts cleansed and dried by small pledgets of wool twisted on the aural forceps (Fig. 629). Excessive growth of hair may obstruct inspection; so may inflammatory swelling or undue narrowness and upward curvature of the canal. The membrana tympani will usually readily

come into view, and its colour, curvatures, and condition as to perforations must be carefully studied. The handle of the malleus can generally be seen directed downwards and backwards, and the triangular "light-spot" passes from the extremity of the handle downwards and forwards. The "light-spot" is said to be due to the curvature of the membrane brought about by the inward traction of the handle of the malleus, and direct reflection of the incident rays to the eye of the observer. The existence and position of the "light-spot" should especially be studied; it is absent or shifts its position when the drum is thickened or altered in curvature. Should the membrane be largely destroyed, the pink inner wall of the tympanum will be visible, and possibly one or more of the ossicles also.

Lastly, as a matter of routine, the surgeon should *examine the throat and nose*, paying especial attention to the tonsils, the presence or absence of adenoid growths, and the condition of the anterior nares as seen by the nasal speculum and reflected light. The naso-pharynx should be finally examined by rapidly passing the finger behind the soft palate. As a preliminary, an application of a 5 per cent. cocaine spray is very useful.

In some cases of nerve deafness and tinnitus it becomes needful to study carefully the general constitutional condition of the patient by an elaborate medical examination. Many cases of deafness can be instantly recognised, others are obscure and difficult; in few, if any, can the surgeon dispense with care and method in examination, and a thorough consideration of the general state of health of his patient.

An account of the more important maladies of the organ of hearing will best be divided into affections of the conducting media, and those of the perceptive apparatus—i.e. the semicircular canals, cochlea, and auditory nerve in its origin, course, and distribution. Deafness due to nerve lesions or disease is rare.

Affections of the auricle.—**Injuries of the auricle** are not uncommon from bites, sabre cuts, or machinery accidents, and partially detached portions should never be cut away, but accurately readjusted and sewn together with fine fishing gut and horse-hair. When the auricle is extensively detached, great care should be taken, in replacing it, to maintain the position and patency of the canal. It has happened that the auditory meatus has been occluded by carelessly suturing a severe wound of the auricle. In burns complete closure of the canal is very likely to occur, unless a tube be worn during the healing process.

Skin affections.—The skin affections of the auricle are numerous. *Eczema* is common and often inveterate, and is found



Fig. 020.—Aural Forceps.

in all varieties. Acute pustular eczema is often excited by contagion from a purulent discharge from the canal. In delicate fair children the discharge of a pustular eczema about the ear, laden with organisms, will frequently infect other parts, and spread extensively over the face and body. Chronic eczema often exists in the meatus and canal, the subsequent infiltration leading to narrowing of the parts. Seborrhœic eczema is found in this region, and the epidermic scales may accumulate in the canal and block it. *Herpes* is not infrequent on the auricle, and may be followed by troublesome neuralgia or obstinate ulceration, especially in the

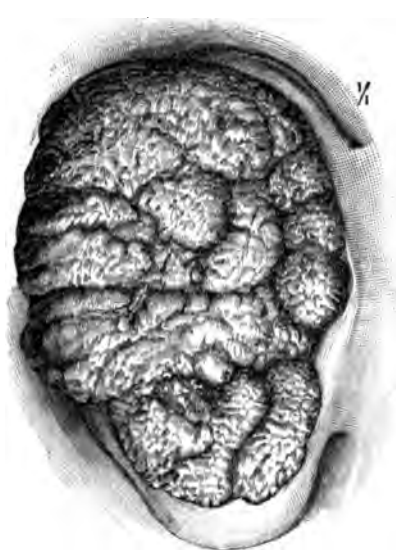


Fig. 630.—Epithelioma of the Canal and Auricle.
(St. George's Hospital Museum.)

aged. *Ichthyosis* is found in association with general congenital ichthyosis, and a deformity of the lobule of the ear. *Lupus erythematosus* is common as a bilateral dry patch, with adherent white scales on the summit of the pinna. It is usually met with in women of about forty years of age. It may be associated with the well-known "butterfly patch" on the face, and similar spots on the hairy scalp. *Lupus vulgaris* more rarely attacks the auricle. It is unilateral, and causes extensive destruction of tissue. The auricle may be much deformed in the nodular form of *leprosy*. *Syphilides* occur upon the auricle, and condylomata round the

meatus auditorius. In the same position ulcerations occur in late syphilis, which may closely simulate epithelioma. The various forms of *erythema* may be found, and so may erysipelas; and the latter affection is apt to become chronic, and produce permanent thickening. The pearly white tubercles of *molluscum contagiosum* occur on the auricle, and morphaea sometimes affects the skin in the course of one of the auricular cutaneous nerves. Ulcerations of the margin of the pinna are found in the extremes of heat and cold, and in *Raynaud's disease*. The blebs of *peniphigus* may form on the auricle in general attacks of this malady.

The treatment of all skin affections of the auricle is conducted on purely general principles. In chronic or sub-acute eczema the dilute mercurial ointments and mild empyreumatic preparations, combined with careful dietetic and medicinal treatment, will

generally give good results, provided that the dressings are properly applied. It will be remembered that the opinion is gaining ground that eczema is a parasitic disease, and remedies calculated to affect such conditions are likely to prove beneficial. In all cases a careful examination of the canal should be made, for it is useless treating an eczema of the auricle really dependent upon a contagious discharge, unless the latter be checked.

New growths of the auricle.—Malignant disease may attack the auricle in the form of *epithelioma* (Fig. 630), and rodent ulcer is not uncommon. I have treated one case of melanosis of this part. *Warts, hairy growths, and sebaceous cysts* are found, with dermoid cysts, in the vicinity of the auditory canal. *Cheloid* is met with in the lobule, about the openings for "ear-rings." *Nævoid growths* and aneurysm by anastomosis are also found in the auricle. *Adenomatous* tumours of the sebaceous glands are occasionally seen in this locality. All these affections are treated on general surgical principles. A dermoid cyst may absorb the bone, and is apt to lie deeper than expected. Cheloid of the lobule had best be left alone, but if increasing and very unsightly, it may be freely excised, the incisions going wide of the growth, and immediate union being brought about by accurate suturing. Cheloid must not be confused with pendulous soft fibroma, which is common on the lobule of the ear. In malignant disease and extensive rodent ulcer very free extirpation is needful, and the surgeon should remember that even removal of the entire auricle does not noticeably damage the hearing. Aneurysm by anastomosis may be treated in a variety of ways, but excision, keeping wide of the growth, is usually preferable.



Fig. 631.—Hæmatoma Auris.

Hæmatoma auris.—This well-known affection presents itself as a doughy or fluctuating swelling, which in bad cases may fill up the whole of the concave surface of the pinna (Fig. 631). It is purplish in colour, and common in the auricles of the insane, especially those suffering from general paralysis. This affection may be caused by injury, and is seen in the auricles of football players.

The true pathology of the "asylum ear" is uncertain, but the affection has been attributed to an obscure morbid condition of the peripheral vessels in the insane, and to central cerebral disease, causing local lesion.

Repeated evacuation of the effused blood by means of a fine and clean syringe, with subsequent pressure, will often effect a cure. Should suppuration ensue, the swelling must be freely laid open, and the pus and disintegrating clot evacuated. I have known more than one of these swellings to contain clear serous fluid, and have treated them by aspiration and small injections of diluted iodine with success. In cases of hæmatoma severe inflammation, with subsequent suppuration and destruction of the cartilage (perichondritis), may be found.

Sloughing inflammation of the auricle is very rare, but is met with in ill-nourished children after the specific fevers. Gangrene may in such cases spread down the canal, and usually provè fatal.

Congenital affections.—The auricle is formed by the coalescence of six tubercles round the dilated margin of the first visceral cleft. These may remain permanently separate. The auricle may be smaller than normal (microtia), doubled over or convoluted. The



Fig. 632 — Auricular Appendages and a Branchial Fistula in the Cheek.

meatus or canal may be obliterated, and nerve deafness and congenital facial paralysis may also be observed. In these cases operations are sometimes done for appearance sake, but the surgeon will be cautious how he attempts to form an auditory canal, for such operations rarely if ever succeed. Imperfection of the perceptive apparatus is very common, and even though an opening be made, it usually persistently closes. If the sounds of a tuning-fork cannot be heard

through the bones, any hope of restoration of hearing is hopeless.

Branchial fistulæ are often associated with these cases, and small rudimentary auricles, like those of the goat, have been seen on the side of the neck (polyotia) in the position of the visceral clefts (Fig. 632).

Protuberance of the auricles is sometimes excessive, and may be remedied by some form of apparatus designed to keep the ear pressed against the side of the head, or in extreme cases appropriate "skin flaps" must be removed posteriorly, and the edges of the incisions carefully united. Considerable improvement may confidently be expected.

Lastly, tongue-shaped auricular appendages are sometimes seen on



Fig. 633.—Scoop and Screw for Wool.

the tragus or antitragus. They are composed of connective tissue and fat, and may be readily removed.

Neuralgia of the auricle.—Such sensations as tingling, burning, flushing, are often experienced in the auricles of the gouty. The neuralgia of herpes has been alluded to. It must be carefully remembered that severe pains in the course of the numerous nerves which supply the pinna and auditory canal are often due to important causes very remote from the ear, as carious molar teeth, cancer of the tongue, tumour of the neck, or caries of the upper cervical spine.

Affections of the auditory canal.

Impacted cerumen.—This is a common and important cause of deafness, and it is worthy of especial remark, that the pressure of a hard, ceruminous plug on the drum causes such symptoms as vertigo, confusion of thought, and even epileptiform attacks, which have been repeatedly mistaken and treated for cerebral disease. The symptoms, also, often come on suddenly, from the swelling of the mass induced by the entrance of cold water in bathing; or they may spontaneously disappear from the softening or shifting of the cerumen. The diagnosis of impacted wax is obvious on using the speculum. Ceruminous plugs vary much in consistence, and an important variety of the affection is that associated with seborrhoeic eczematous inflammation and desquamation of the epithelial lining of the canal. The plugs in these cases are especially adherent and difficult to remove. In ordinary hands the syringe is the only implement to be used in the removal of cerumen (Fig. 634). The auricle being pulled upwards and backwards, a steady

stream of warm water is directed along the upper wall of the canal, and perseverance seldom fails to expel the mass. In obstinate cases, a preliminary softening with oil, glycerine, or weak warm solutions of soda or potash expedites removal. As a rule, when the plug is expelled, complete relief of all the symptoms is experienced. Prognosis should be guarded until the wax is removed, for other conditions may exist, as nerve deafness, perforations of the drum, or chronic catarrh of the middle ear. In a few instances a scoop may be used, as shown in Figs. 633 and 635.

In connection with this subject may be mentioned the presence of *vegetable fungus in the canal*. The *aspergillus niger* is the form of growth said to be most common. It gives rise to many of the symptoms of impacted cerumen, and is to be diagnosed from it by

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Fig. 634 — Aural Syringe.

the peculiar punctated black appearance, as though gunpowder had been strewn into the canal. The masses are peculiarly adherent, and the parts left, on their removal, raw and tender. Of the many applications advised for this affection, none give better results than the thorough instillation of a warm alcoholic 5 per cent. solution of salicylic acid, the loosened masses being afterwards removed by the



Fig. 635.—Scoop for Cerumen.

syringe or forceps. Afterwards dilute lotions of boric acid may be applied. The microscope should always be used to complete the diagnosis, the characteristic spores and mycelium being readily detected.

Exostosis.—Bony growths of the auditory canal are divided into—(a) the multiple ivory osteoma or exostosis; (b) the cancellous osteoma or exostosis more or less pedunculated; (c) inflammatory periosteal formations. The principal causes that have been assigned for these growths are: irritation of the ear from constant bathing and diving, the gouty diathesis, and the irritation of the discharge of an otorrhœa. Some authors assert that polypoid growths may become calcified.

The cancellous pedunculated exostosis, commonly growing from the posterior wall of the canal, is usually readily removed by a long slender pair of forceps, such as dentists employ for upper incisor stumps, by a strong wire snare, or, if its base be broad, by a fine gouge, the auricle being detached posteriorly, if needful, to obtain close access. In the case of multiple exostoses, the operation by the drill and dental engine is usually selected, a small drill being first employed, and the opening gradually enlarged. The electro-

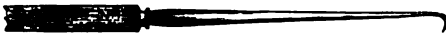


Fig. 636.—Sharp Hook for foreign Bodies in the Canal.

motor may also be employed, but not at full speed. A good light, a suitable couch, and excellent assistance are essential for these proceedings, and it has been advised to pass a guard beyond the growths when this is possible. A deeply-seated broad, hard exostosis, occurring in a narrow and curved canal, is a difficult and anxious case, and much consideration must be given to it before operating. It must not be forgotten that, in many cases of exostosis, if the ear be occasionally cleaned by a small spatula and the woolholder, the space between the growths, or the growths and bony parietes, is sufficient for useful hearing, and no operative proceedings are needful. Syringing in cases of exostosis should generally be avoided.

The cases which demand operation are:—(a) Extreme bilateral deafness; (b) the presence of otorrhœa and pent-up discharge behind the exostosis. The operation, if carefully performed by an experienced

person, is not very risky ; and unilateral deafness may be so troublesome, that the patient will gladly submit to operative treatment for its relief. Small fragments of bone not infrequently necrose and separate after drilling, and exuberant granulations, for a time, quite close the canal. The inflammatory periosteal formations of syphilis are often improved by large doses of iodide of potassium. They never completely block the auditory passage.

Foreign bodies in the auditory canal.—

These cases are principally found in children and insane persons, who push into the ears such substances as beads, buttons, teeth, tin-tacks, pebbles, peas, fruit-stones, and the like. For purposes of treatment, foreign bodies may be divided into hard impacted substances, as a pebble, and soft bodies, as a roll of paper, which do not entirely fill the canal. The latter are usually readily expelled by the syringe. A small sharp hook (Fig. 637) may be used for a bean or pea, or such a substance may be seized by forceps. Hard impacted foreign bodies furnish some of the most difficult and most dangerous cases in surgery, and injudicious or unskilled attempts at extraction enhance this description. In the vast majority of cases, the syringe, if properly and perseveringly used, seldom fails to expel the substance. The patient should be placed on the side with the affected ear downwards, and the head hanging over the side of a bed or table. The auricle being well pulled backwards to straighten the canal, a powerful jet of water is thrown from below along the posterior wall. Children should be anaesthetised for this and all other operative proceedings connected with foreign bodies in the ear. In the rare cases when repeated syringing fails, cautious and patient attempts at extraction may be made, under full illumination and anaesthesia. Removal is most difficult, and sometimes impossible even in very skilled hands. A wire loop like the old-fashioned cataract vectis is very useful, and so are small blunt or sharp hooks, which can be passed between the canal and the foreign body (Fig. 637). Frequently, by these means, the position of the substance may be so shifted that the syringe will act upon it. Each case demands careful study and appropriate instruments, and the aid of a surgical instrument-maker is often essential. Some impacted, sharp, foreign bodies pressing upon the drum, or causing ulceration and excessive pain, have been removed by detaching the auricle posteriorly, and chiselling along the posterior wall of the canal. Before undertaking this, or, indeed, any serious operative proceedings for the removal of foreign bodies from the ear, the surgeon will not fail to recollect that many of these substances, if left alone, do no harm whatever, and frequently



Fig. 637.—Hook, for Foreign Bodies in the Canal.

gradually shift externally into positions whence they may readily be extracted. I have removed a small pebble which had remained for upwards of seven years in the auditory canal of a child, without causing any serious symptoms, and many similar cases are reported. Towards puberty a considerable enlargement of the canal takes place, which permits the ready removal of previously impacted foreign bodies by the syringe.

The "agglutinative" method of Lowenberg has the merit of being harmless, and is sometimes successful. That writer advises that a small camel-hair brush dipped in the strongest glue should be passed down to the foreign body, and the hairs of the brush by gentle pressure made to surround it. The parts are then packed with cotton wool and left alone for two or three days, when cautious extraction may be attempted.



Fig. 638.—Congenital Obliteration of the Canal.

Insects, as bugs or beetles, will readily crawl out of the ear if it is filled with warm water, or the aid of the syringe may be invoked. They cause intense agony and discomfort by scrambling against the drum. Maggots have been found in cases of neglected otorrhœa, and are best destroyed and removed by the application of carbolic lotion (1 in 40), followed by the use of the syringe. The vapours of chloroform, or of cyanogen from a moistened piece of cyanide of potassium, will prove rapidly fatal to insects.

Closure of the auditory canal.—Obstruction of the audi-

tory canal, as has been pointed out, may be congenital (Fig. 638), or due to the cicatrization of burns or wounds. In very rare cases a septum of cicatricial tissue may partly or entirely close the canal in its deeper parts. In old age the walls of the cartilaginous portion collapse and fall together, increasing the deafness that then naturally exists. The most important cause in practice, of narrowing of the canal, is chronic eczema with infiltration and thickening of the soft parts.

These cases are difficult to treat. General dietetic and medicinal treatment for eczema is essential. Locally, dilute carbolic, lead and spirit, and tar lotions are useful, and so are the dilute mercurial ointments. I have frequently employed small leaden tubes for these cases, larger and larger tubes being inserted as the passage dilates. It is needful for the patient to wear the tubes for a considerable time, and they may be coloured pink to avoid observation. After the removal or extraction of large sequestra,

cicatrisation of the canal with closure may occur. Such conditions are best left untreated.

Furuncles of the auditory canal.—Small boils, which are painful and often obstinately recurrent, form in the auditory canal. They are dependent upon organisms, especially the staphylococci, and are found in the plethoric, gouty, and diabetic, those exposed to unhealthy emanations, who lead sedentary lives, and in the anæmic and constipated. There is almost always some hygienic, dietetic, or constitutional defect to remedy. Locally, hot sedative lotions may be freely applied, and should the pain be severe, an incision may be made with a cataract knife under nitrous oxide gas. There are few local remedies which appear more beneficial in these cases than an alcoholic solution of boric acid. Suppurating sebaceous cysts are closely analogous. They may be freely opened under anæsthetics, and their contents evacuated with small spoons, after which they must be "dressed from the bottom" with iodoform or boric acid.

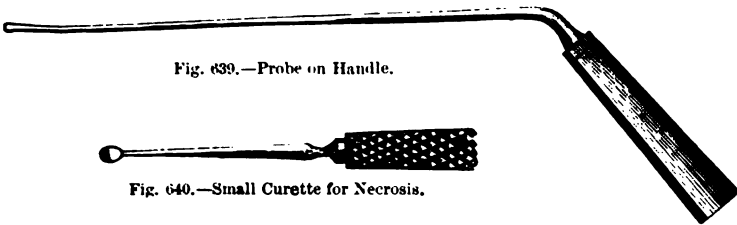


Fig. 639.—Probe on Handle.

Fig. 640.—Small Curette for Necrosis.

Inflammatory conditions of the auditory canal.—These may be due to various causes. Acute inflammation, with swelling, pain, deafness, and painful mastication, may be associated with the entrance of irritants into the ear, cold—especially cold water in diving or swimming—and the irritation of parasitic growths, impacted wax, or foreign body. The inflammation may be erysipelatous, eczematous, or syphilitic. In rare cases diphtheritic membrane has been deposited on the walls of the canal. The local swelling, heat, and pain, and the deafness and closure of the canal, usually are sufficiently diagnostic. The treatment is by warm and sedative affusions, which should be constantly soaked into the parts, the free abstraction of blood by leeches, and the internal administration of calomel. Should the swelling and tension be excessive, an incision under nitrous oxide gas may be needful. Causes of irritation must be removed, and all local manipulations conducted with care and gentleness.

New growths and ulcerations of the auditory canal.

—Sebaceous and dermoid cysts and the well-known tubercles of molluscum are found in the auditory canal. The initial lesion of syphilis is here exceedingly rare, but condylomata are sometimes met with, and so is syphilitic ulceration in the later stages of the malady. Syphilitic ulceration may closely simulate rodent ulcer or epithelioma. The diagnosis and treatment of all these conditions is to be conducted on general principles, but dermoid cysts may absorb the

bone and lie deep. Their removal must be undertaken with caution.

Caries and necrosis of the auditory canal.—Caries and necrosis of the auditory canal are important causes of otorrhœa. Frequently sinuses open here from the mastoid cells, or a pyæmic parotid abscess may evacuate itself by this route. Polypoid masses of granulation tissue may surround the orifices of the sinuses, and are readily mistaken for more serious forms of growth. Acute periostitis and necrosis are found after the specific fevers. Inflammation of the canal involving the periosteum needs a free incision down to the bone or cartilage. Caries and necrosis may frequently be treated with benefit by the removal of sequestra, and the use of small sharp curettes (Fig. 640). Towards the roof of the canal the operator will proceed with caution, as the layer of bone separating the canal from the cranium may be exceedingly thin. Should the sequestra be large and fixed, the utmost caution must be employed before undertaking an operation for their removal.

Affections of the middle ear.—In considering this extensive and important subject in a short and concise manner, the reader will recollect that the middle ear is a mucous cavity, the lining membrane of which is continuous with that of the naso-pharynx, that this mucous membrane is intimately connected with the bone, of which it may be considered to be the periosteum, and that ulcerative affections of it are readily propagated to the subjacent osseous tissue. The middle ear contains the delicate chain of ossicles, with thin joints and synovial membranes, and is bounded on the outer and inner walls by fibrous membranes. The anatomical relations of the tympanum to large blood-vessels and the cranial cavity are of vast importance. The inflammatory affections of the middle ear, therefore, are those of any mucous cavity, and the results are to be explained by the peculiar structures contained in it, and by its anatomical surroundings. The classification of varieties of inflammation of the middle ear may be made elaborate, but in practice it will be found that certain main types are usually met with, the consideration of which will serve as useful guides to others. These are as follows :—

1. Acute inflammation with or without suppuration.
2. Sub-acute inflammation with or without exudation of mucus.
3. Chronic inflammation (chronic aural catarrh).

1. Acute inflammation with or without suppuration.

—This painful and dangerous affection is produced by a variety of causes, and important predisposing conditions are a low state of health, as after the specific fevers, and especially previous ear disease, old perforative otorrhœa, in which condition acute inflammation is readily created. The most important *exciting causes* are (a) extension of inflammation from the naso-pharynx in septic ulcerative affections, in scarlet fever, measles, diphtheria, after operation on the naso-pharynx, as plugging the nares, or the removal of adenoid growths; (b) from blows on the ear, the congestion consequent upon extreme cold, and especially the entrance of cold sea water into an ear affected

by old perforative otorrhœa in diving or swimming; (c) operations upon the Eustachian tubes or tympanum, and the injection of fluids into the tympanic cavity.

The leading *symptoms* are fever, agonising pain of a "throbbing or hammering" nature in the ear and over the side of the head, and



Fig. 641.—Paracentesis Knife.

extreme unilateral deafness. The canal is frequently swollen and tender, and the membrane, if it can be brought into view, is reddened, convex externally, and it may actually bulge, should pus be present. The fibrous structure of the drum, however, does not allow of much yielding unless a considerable amount of intra-tympanic pressure exists. The drum is always acutely inflamed. Some authors describe acute inflammation of the tympanic membrane as a separate affection (acute myringitis). In practice it will generally be found that inflammation of the lining membrane of the tympanum, or auditory canal, co-exists. The glands about the parotid region are tender, and movements of the jaw intensely painful. This affection is common in young children, causing fever and "head symptoms," the child shrieking and crying constantly, will frequently rub its hand over its ear, and be soothed by hot applications to the side of the head. Every variety of the acute inflammatory process is met with from the acute catarrhal inflammation with little exudation (dry catarrh) to the savage and intractable suppurative inflammation of scarlet fever, which speedily destroys the drum by pressure and

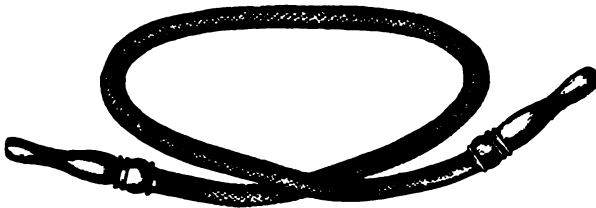


Fig. 642.—Diagnostic Tube.

ulceration, and involves the contents of the tympanum in common ruin.

The *treatment* of acute inflammation of the middle ear must be prompt, and, in the strong and robust, energetic. Leeches should be applied in front of the tragus, and the surgeon must not be timid in the local abstraction of blood by this ancient but valuable method. Afterwards hot applications are most grateful, especially dry heat, as from a flat bottle of hot water, a heated sand-bag, or a piece of "spongio-piline." Free mercurial purgation should at once be

carried out, and the diet reduced to slops. The subsidence of the agonising pain under this treatment is often immediate and marked.

Though some writers decry the use of leeches, I most strongly advise their employment in suitable cases where as yet the lateral sinus is unaffected by purulent phlebitis, and the meninges are not attacked. The question of the necessity for performing paracentesis of the drum is always a difficult one. Should there be reason to suspect that pus has formed, it is well to make an exploratory incision with a proper knife (Fig. 641) behind the handle

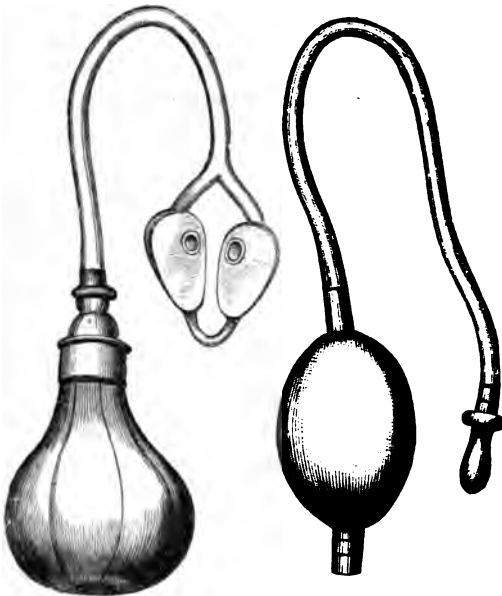


Fig. 643.—Poltzer's Bag with Allen's Nasal Pads and Nose-piece.

of the malleus. Should pus not be present, the cut speedily heals, and does no harm. In children, and the nervous, anæsthetics are needful for this operation. The treatment of acute middle ear inflammation by morphia and "poultices" is decidedly to be deprecated. The flow of pus must be encouraged by warm syringing, and the treatment for otorrhœa persevered in. In many instances the wound in the drum speedily heals, and the hearing is well restored. Should there be pain and tenderness over the mastoid region, the mastoid cells had better be opened, and careful watch must be

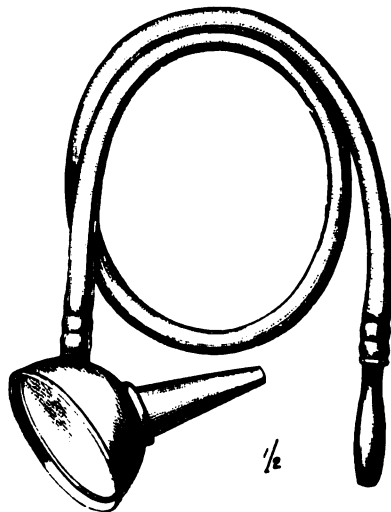


Fig. 644.—Siegel's Pneumatic Speculum.

kept over such cases, especially with reference to pyæmic symptoms.

2. **Sub-acute inflammation with or without exudation.**—The vast majority of these common cases originate in a "cold," the catarrhal inflammation spreading up the Eustachian tubes to the tympanum. The affection is especially found in those who suffer from adenoids and enlarged tonsils, and who are constantly exposed to cold, wet, or draughts. Some cases are associated with the congestive and ulcerated sore throat of secondary syphilis, and this fact is of vast importance in treatment. Slight cases are generally overlooked, and the subsequent inflammatory changes end in chronic deafness. The amount and nature of the exudation varies, from thin watery mucus to thick, viscid, and gummy secretion.

The leading *symptoms* of this affection are deafness, more or less sudden in onset, tinnitus, a sensation of dulness or "stiffness" in the ear, with bubbling or crackling sounds, especially on mastication, or moving the head into certain positions. The tuning-fork is heard with remarkable length and plainness on the deaf side, from the vertex or teeth. If the ear of the patient and surgeon be connected by a bone-tipped tube (Fig. 642), and inflation be practised by the use of Politzer's bag (Fig. 643), the bubbling of fluid may usually readily be recognised. The drum may distinctly bulge, or the fluid be visible through it. The *treatment* of this affection is thus conducted. Inflation, by means of Politzer's bag, or the Eustachian catheter, must be regularly carried out. The naso-pharynx must be cleansed by a simple alkaline douche, and afterwards well brushed with astringents. The general health needs careful attention. Vapours may be used, especially that of chloride of ammonium, the patient attempting, by holding the nose, shutting the mouth, and gently practising expiration, to convey the vapour towards the tympanum. Should there be excessive secretion, paracentesis may be performed, and the exudation forced outwards by Politzerisation; but this, in my experience, is seldom needful. Long continued and methodical inflation by Politzer's process is the great essential of treatment. Occasional leeching in front of the tragus is also very beneficial.

3. **Chronic inflammation (chronic aural catarrh).**—This affection, which is responsible for a large number of cases of incurable deafness, frequently has its origin in repeated attacks of slight, unheeded catarrhal inflammation spreading from the pharynx. It gets worse with advancing life, especially in the rheumatic or gouty, whose tissues are prone to suffer from fibrosis and calcification, and it is common in sailors, fishermen, fen-men, night-watchmen, and others exposed to the vicissitudes of the weather. In many cases it is distinctly hereditary, and its progress may be so slow and insidious, that no exciting cause can certainly be ascertained.

Pathologically in these cases the Eustachian tubes have been found obstructed and narrowed, the mucous membrane of the tympanum thickened, the joints of the ossicles ankylosed, the membrana tympani and secondary membranes chronically thickened or calcareous,

and the stapes anchylosed in the fenestra ovalis. When once chronic inflammation of the middle ear has become established, it is apt to progress, and in marked cases of this affection all treatment is very unsatisfactory. Many varieties of this affection are described. The effects of chronic inflammation in the tympanum are as rebellious to treatment as in other parts of the body.

The *diagnosis* rests upon the gradual onset and slow but sure progress of deafness. Tinnitus, of a seething or roaring nature, is an early symptom, and in advanced cases constitutes the chief trouble of the sufferers. The canal is dry and devoid of cerumen, the membrana tympani retracted and lustreless, or obviously thickened and rendered opaque by chronic inflammation. In sufferers from chronic gout calcareous plates may even be visible in the drum. The tuning-fork is heard long and loud through the bones, and consequently hearing with a "trumpet" is usually satisfactory. Most of these patients hear better in a noise, as a railway train (*paracusis Willisii*). The Eustachian tubes may also be stric-tured.

The mobility of the drum outwards may be estimated by using Siegel's speculum (Fig. 644). The observer looks through the instrument, and simultaneously exhausts the air by the mouth-piece, or an assistant may connect the mouth-piece with an exhausting syringe.

Beyond careful attention to the general health, the avoidance of cold and wet, and strict attention to the condition of the nose and throat, little can be done for these cases. Such local methods of *treatment* as injections into the tympanum, the passage of bougies up the tubes, electricity, and excision of the membrana tympani or ossicles, are apt to be followed by disappointing results, and the latter operation should not be undertaken without great experience and grave consideration.

In cases where the Eustachian tube is occluded by swelling or organised inflammatory products, inflation by the *Eustachian catheter* may be needful (Fig. 645). The employment of this instrument in children or nervous adults is difficult. Eustachian catheters are made of all possible sizes and shapes. I prefer the vulcanite instruments, and they should be well cleansed after employment. The use of the instrument requires some experience, and it is by no means always easy, even after long practice, to



Fig. 645 — Eustachian Catheter.

lodge it certainly within the tube. A little 5 per cent. solution of cocaine may be thrown into the nares, and "snuffed up" by the patient into the naso-pharynx. The head of the patient reclines against the arm of the operator, who, taking the catheter lightly between the thumb and little finger of the right hand, passes it quickly along the floor of the nose, with the beak downwards, until it touches the posterior wall of the pharynx. The instrument is then turned inwards and a little withdrawn until it impinges

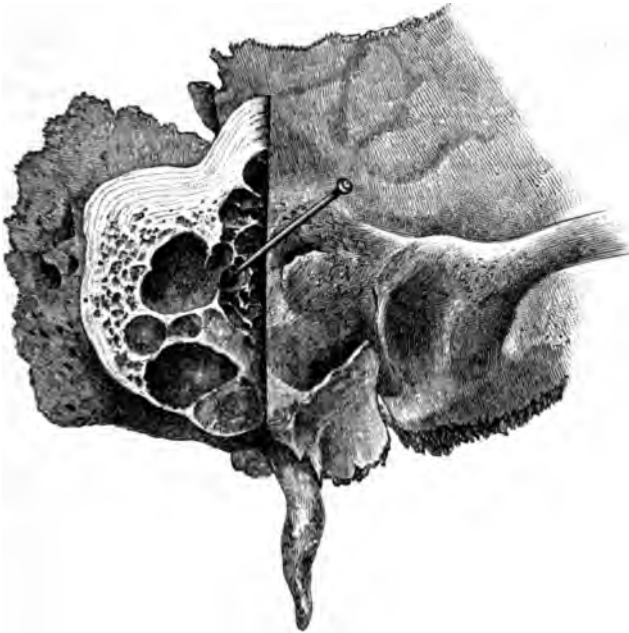


Fig. 646.—Vertical Section of the Mastoid with Pin passed into the lateral Sinus, half an inch behind the margin of the external auditory canal.

upon the back of the septum nasi. It is finally rotated outwards and upwards, when the beak will almost certainly lodge in the tube. These manœuvres should be executed continuously and quickly. Deformities of the septum and turbinated bones, new growths, and the cicatricial contraction of ulcers, may make the passage of the catheter impossible. When the instrument is in position, inflation may be carried out by a small bag, the nozzle of which accurately fits the orifice of the catheter. This bag may be filled with the vapours of chloroform, iodine, or oil of pine wood. Lately some success has been claimed in cases of chronic Eustachian obstruction by exhausting the air in the external canal, and thus drawing the drum outwards, for some hours daily. This could hardly succeed if adhesions were present, and it has been advised to divide

these with a fine knife. Such methods of treatment demand careful consideration before adopting them, as well as good operative skill.

Affections of the mastoid. Acute mastoiditis.—This acute and painful affection rarely attacks healthy persons, but is not infrequent in old cases of perforative otorrhœa, where it is excited by

cold, the entrance into the tympanum of sea water, or inflammation spreading by way of the tympanum in the ulcerative "sore throat" of scarlet fever. I have seen it follow the specific fevers, and as a sequel to influenza. Its causes and symptoms are much those of acute middle ear inflammation, with which it is often combined. The agonising pain is, if possible, more marked, and is referred to the mastoid; much tenderness is experienced on pressure, and the periosteum is usually soon implicated, the soft parts being red and shining, the auricle pushed away from the head, and the canal almost obliterated by inflammatory swelling. The intolerable pain may terminate in delirium, and has been known actually to prove fatal in delicate persons.

Chronic mastoiditis, with necrosis and accumulation of cheesy debris.—This condition of the mastoid cells is not uncommon in old cases of perforative otorrhœa, the cellular cavities being stuffed with the products of inflammation and the bone often much thickened by chronic inflammation; swelling posteriorly and deep-seated pain are common in these cases, and otorrhœa, with granulations in the canal, may be kept up indefinitely.

Extensive necrosis of the mastoid is found after measles and scarlet fever in children and in adults, in bad cases of syphilis, tuberculosis, and diabetes.

In all these affections *an opening into the mastoid antrum is essential*, and in acute mastoiditis this cannot be performed too soon, the instant relief to the symptoms being very striking. In children an opening may readily be made in the shell of bone, with any blunt-pointed instrument. In adults, and especially when the bone is sclerosed, the operation is more difficult. Where there is much cheesy *débris*, and the cellular cavities are stuffed with the products of inflammation, a very free opening is needful to admit of the

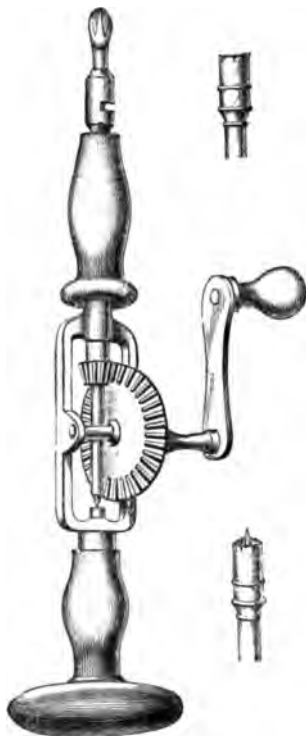


Fig. 647.—Trephine, and Rose-headed Burr for Mastoid Operations.

introduction of scoops and spoons, and the complete evacuation of debris and fragments of necrosed bone.

Operation.—When it is merely needful to make an opening for the relief of tension in acute inflammation, a free vertical incision down to the bone should be made behind the auricle, and the soft parts well held asunder by retractors. With a small trephine (Fig. 647), or a small sharp gouge, the operator then makes an opening close behind the posterior margin of the canal, and as he deepens it, he is especially careful to direct his instrument downwards and forwards, exactly parallel to the canal, a probe being kept in the latter for guidance. When the inflamed cells are opened, free hæmorrhage will frequently ensue, alarming to the inexperienced, which will cease on hot syringing. The bleeding from the soft parts is readily arrested by the application of pressure forceps. When the bone is sclerosed, or a large opening has to be made, the whole mastoid may be exposed by converting the above incision into a T-shaped one, or I prefer to form a large flap at the outset, turning the auricle forwards. Any soft spots of bone are thus seen and can be followed up, or existing sinuses enlarged. Small sharp gouges (Fig. 648) may be used to deepen the opening, the bone being removed layer by layer, and in old cases the operator may have to work to the depth of half an inch before the cavities are fully opened. By operating close to the posterior margin of the auditory meatus, and working forwards, the lateral sinus is always avoided. The position and depth of the latter are very uncertain; and in lightly-formed temporal bones it may come forward close behind the canal before it makes the S-shaped bend (Fig. 646). Hence the necessity for proceeding with caution. Lately much success has been obtained in bad cases of mastoid necrosis by detaching the auricle freely posteriorly and chiselling away the posterior wall of the canal. The remains of the drum are removed, any carious fragments of ossicles and the upper part (attic) of the tympanum thoroughly curetted away. Care must be taken to avoid injuring the facial nerve. (*See also page 197.*)

Wound of the sinus is at once known by the profuse venous hæmorrhage, the jet of dark blood reaching to the height of several inches. The accident, though alarming, is by no means fatal, and if the opening be plugged with iodoform gauze, the hæmorrhage is readily controlled, and healing will probably take place. When a free opening is established, much fœtid cheesy *débris* may be evacuated by spoons (Fig. 649). On syringing, the hot water mixed with discharge will usually flow from the meatus auditorius. Finally, the cavities are mopped with pure carbolic acid, filled with iodoform, and a metallic drainage tube is inserted. The benefit, both locally and constitutionally, that follows this operation is frequently marvellous; otorrhœa ceases, granulations dwindle, and the patient rapidly puts on flesh and strength. Before any operation on the mastoid, the hair must be shaved, the parts well cleansed, and all the instruments rendered aseptic. A pad of iodoform gauze forms the best superficial dressing, and the flap can be accurately adjusted with

horse-hair. It will be remembered that severe cases of mastoid disease and inflammation may be associated with extensive necrosis, extradural abscess, or sinus thrombosis, which, if suspected, necessitate, for proper exploration, a far more free removal of bone with an electromotor, or dental engine. This subject is dealt with in detail elsewhere (page 197).

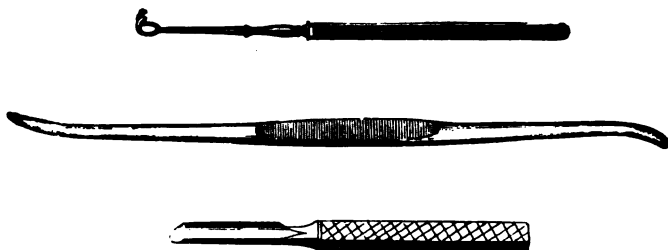


Fig. 648.—Retractor, Periosteal Elevator, and Gouge, used in mastoid operations.

I strongly advise against the use of drills or other pointed instruments in opening the mastoid. The operation by a small trephine, aided by careful application of fine gouges and chisels, is safer, and gives a more satisfactory opening.

Periostitis of the mastoid.—Mastoid periostitis is frequently associated with osteitis, necrosis, or caries in the bone beneath, and

few, indeed, are the cases where a single incision to the bone suffices to abolish all the symptoms. In cases of doubt, a free vertical incision through the periosteum may be tried (Wilde's incision). Syphilitic periostitis over the mastoid readily yields to iodide of potassium.

Otorrhœa.—This is an imperfect term, but we usually understand by it, purulent discharge from the canal. The principal causes of pus flowing from the auditory canal are as follows:—

(1) Chronic suppuration

within the tympanic cavity with necrosis, and perforation of the drum, associated with granulations or polypi.

(2) Fistulous openings connected with caries or necrosis in the walls of the canal or in the mastoid cells, associated with polypi in masses of granulations.

(3) Suppurating dermoid or sebaceous cysts in the walls of the canal.

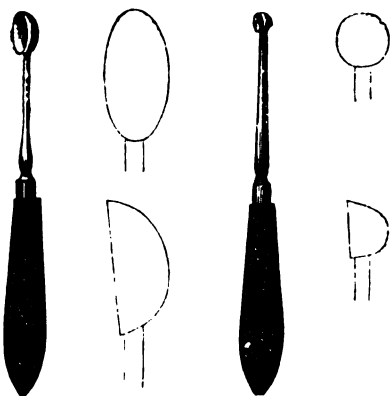


Fig. 649.—Spoons for Mastoid Caries.

(4) Eczematous inflammation of the canal, ulceration caused by foreign bodies, the result of traumatism, burns or scalds.

(5) Abscess bursting into the canal from other sources—as the parotid gland, or from a diseased temporo-maxillary joint.

The first cause of otorrhœa is the more common and important, and perforative otorrhœa should always be looked upon as a condition of gravity, not only on account of deafness, but also because of other serious **complications** associated with the anatomical relations of the tympanum. These are as follows :—

(1) Meningitis and cerebral abscess.

(2) Purulent thrombosis of the jugular vein, with embolic pneumonia, and general pyæmia.

(3) A low condition of health from continual discharge, tubercular infection, lardaceous disease of viscera, inflammation and suppuration of the glands in the neck, and occasionally pustular eczema of the face from the contagious discharge.

(4) Facial paralysis.

(5) The formation of epithelial masses (cholesteatomata) in the mastoid cells.

(6) Rarely, profuse hæmorrhage from the ear from ulceration of the carotid or one of its small twigs.

(7) Very rarely, epithelioma of the canal and tympanum, infiltrating the temporal bone.

It must not be supposed that all cases of perforative otorrhœa end their days from some of these complications. The frequency of this affection is very remarkable, and many hundreds of sufferers from it escape serious mischief. Such individuals, however, live in a condition of risk. Fatal complications are frequently excited by such causes as swimming and diving, or blows upon diseased ears.

Treatment.—The management of perforative otorrhœa is one of the most important of every practitioner's duties, and the indications to be observed are as follows :—

(1) Carry out strict cleanliness, by having the ear well syringed daily with warm and dilute antiseptic and astringent lotions; the surgeon must assure himself that this is thoroughly done with a proper aural syringe. The ear should be gently inflated by the process of Politzer at the same time. The condition of the throat and any nasal obstruction, such as adenoid growths, must receive attention.

(2) Remove sequestra, if possible, and if there be evidences of granulations or polypi, these must be dealt with. In cases of inefficient drainage, with accumulated discharge in the mastoid cells, make an early and efficient opening into these cavities. The opening of the mastoid cells is coming more and more into vogue as a recognised treatment in profuse and persistent otorrhœa.

(3) Attend carefully to the general health, by the administration of tonics, good diet, and especially climatic conditions, and avoid exposure to injuries, cold, or sea-bathing and diving. When discharge

has ceased, instruct the patient to cleanse the ear daily with dry wool, and insufflate some finely powdered boric acid.

Wounds of the drum accidentally or designedly inflicted usually heal readily, and need no treatment, beyond powdered boric acid and a cotton-wool plug in the meatus. It is surprising, especially in children, how many cases of perforation of the drum will improve and ultimately get well under simple cleanliness and strict attention to the nose and throat.

Dry treatment of otorrhœa.—In cases where the flow of pus is diminishing, syringing often seems to do harm, and to increase the tendency to discharge; in these circumstances the dry treatment is very effectual, the discharge being well wiped away with pledgets of cotton-wool wrapped upon a fine probe; the canal is filled with finely-powdered boric acid, oxide of zinc, alum, or these powders mixed in different proportions with iodoform. This treatment is often very effectual. The margins of a perforation may be stimulated by painting on, with a fine camel-hair brush, solutions of alum, nitrate of silver, or zinc.

Use of astringents.—Solutions of astringents used in cases of otorrhœa must be warm and very dilute. The salts of zinc or lead are useful, and may be mixed with carbolic or boric acid.

Removal of remains of drum, and excision of ossicles.—On several occasions I have extracted a carious malleus from the tympanic cavity by slitting the drum downwards from a perforation superiorly. These operations require much consideration, and should never be attempted lightly. The presence of rough and carious ossicles, as detected by a fine probe, is an important indication. I believe that there is much promise in this operation. It should not be attempted unless the ossicles are definitely carious, mastoid antrectomy being preferable.

Danger of meddling with old cases of otorrhœa.—In cases of what well may be termed quiescent perforation, where the discharge is scanty or has long ceased, and slight fœtor at the meatus is the only external evidence of deeper mischief, interference is especially dangerous. The parts are laden with virulent micro-organisms, which readily enter the vessels of any newly-made wound. Hence the removal of a polypus is full of risk in these cases, and syringing should always be avoided.

Positions and shapes of perforations of the drum.—Perforations of the membrana tympani are infinitely varied in shape, size, and position. Round and dark perforations are generally of old date, recent perforations appearing like vertical slits. An important variety is that of perforation in the "*membrana flaccida*" at the upper part of the drum. Discharge cannot well escape, and is confined within the tympanic cavity, and especially in the "*attic*" of the tympanum. The patient suffers from fever, pain, and drowsiness, which are relieved by a sudden discharge of pus, but the symptoms regularly recur. From its position and small size this perforation is peculiarly liable to be overlocked, and here a polypus

often originates. It is believed that perforations are most common in the posterior part of the drum behind the handle of the malleus, though there is some difference of opinion regarding this point, and the author cannot regard it as definitely settled.

Use of the artificial membrane in perforative otorrhea.—

In many cases of perforation, especially where the drum is extensively destroyed, a notable improvement to the hearing may be effected by the use of an artificial support, always supposing that the stapes is still in its proper position. Of the many kinds of "artificial drums" in vogue none are so safe and good as a moistened pellet of cotton-wool, which may well be impregnated with boric acid or iodol. By means of a light pair of forceps this is passed down to the perforation, and gently pressed upon it (Fig. 650). After a few lessons the patient learns to do this himself. Any discharge is absorbed, and the pellet may be removed every night to be replaced in the morning. Many "artificial drums" are the inventions of the charlatan, and those made of leather, metals, or other unyielding material should be carefully avoided. The wool pellet, when well fitted, acts as a means of conveying vibrations to the stapes, and so improving the hearing. It absorbs discharge, and keeps the canal clear. It protects the cavity of the tympanum against cold and dust, and may be looked upon as a most valuable adjunct to the treatment of perforative otorrhœa.

Granulations and aural polypi.—An aural polypus is composed of embryonic connective or granulation tissue in various stages of development, moulded by the contour of the canal. Most commonly it is soft, granular and friable, and bleeds easily, but in cases of long standing, development into true fibrous tissue is not unknown. Myxomatous structure is also met with. These growths are covered superficially with squamous epithelium, and commonly have their origin within the tympanum, protruding through a perforation in the drum. In size they may be so small as easily to escape detection, or large enough to protrude from the meatus, when their surface becomes epidermic. When of great dimensions, their weight and configuration may lead to such attenuation of the pedicle that spontaneous extrusion may eventuate.

Aural polypi may also originate in the walls of the canal, or even



Fig. 650. — Artificial Drum and Forceps for inserting it.

from the drum itself, and are peculiarly liable to grow about a focus of carious bone, or the orifice of a fistulous sinus from the mastoid cells.

The *diagnosis* is easily made after cleansing the ear and well illuminating it, but without great care a small polypus the size of a bird-shot may readily be overlooked, and this will keep up a discharge of pus indefinitely. True sarcomatous polypus is exceedingly rare, the tendency to recurrence observed in these growths being generally due to the persistence of the conditions which produced them. Epithelioma is recognised by fetid watery discharge, agonising pain, inveterate increase, infiltration of the soft parts, cachexia, and emaciation, the skin being congested and livid.

A large aural polypus is a source of much misery, and frequently of danger also, from the retention of discharge behind it. There are few cases more urgent in this branch of surgery than "head symptoms" supervening in a case when discharge is blocked from escaping by a polypus.

Treatment.—It will be remembered that as these formations are often associated with caries of the tympanum, removal of them is not devoid of some risk, and considering that the parts are bathed in foul discharges swarming with organisms, a fresh breach of surface may readily be infected. Septic meningitis is the chief danger to be feared from the removal of an aural polypus. It is well for some days to cleanse the ear well by careful syringing and soaking with dilute warm antiseptic fluids, to which rectified spirit may be added in equal parts, should the patient be able to bear it. By these means considerable shrinkage of the growth will also be effected. The patient should recline upon a high couch, and the parts be well illuminated. An assistant draws the pinna upwards and backwards. By this means the polypus will come into view, or, if it be small, a large speculum can be inserted, which will allow of the manipulation of instruments through it. The growth is dried with pledgets of cotton-wool, and its mobility and connections are gently examined with a fine probe. As a general rule, anæsthetics are used, though in the case of small growths, soaking with a 20 per cent. solution of cocaine is usually sufficient.

Removal with the snare.—The essential points in a snare for aural polypus are exceeding delicacy of construction of the barrel, a fine steel wire loop, and a handle which is out of the range of vision of the operator. All these conditions are well fulfilled by the instrument depicted in the accompanying figure (Fig. 651). The loop should be passed well down towards the pedicle of the growth, and as much as possible of it brought away. Smart hæmorrhage may follow, easily checked by warm syringing. The ear is then filled with powdered boric acid, and lightly packed with cotton-wool.

Forceps operation.—Forceps of various sizes, shapes, and patterns are designed for the removal of aural polypi, and for small friable growths are, perhaps, preferable to the snare. The polypus being seized by them is well rotated on its axis and then withdrawn. Sessile growths may be broken up and removed piecemeal; and

if they originate in the walls of the canal, a small sharp curette may be applied to the spot, and the remains of the growth thus eradicated.

Treatment by escharotics.—For granulations, exceedingly small growths, and the remains of larger ones, caustics are useful. They should be applied under a good light, to the diseased tissue only, with a small forceps or caustic holder. Among the chemical agents thus employed are chromic acid, potassa fusa, chloride of zinc, nitrate of silver, and perchloride of iron. I give the preference to chromic acid, which should be passed down into the tissue of the growth; this substance may be conveniently fused on the end of a probe. The process may be acutely painful, and the parts

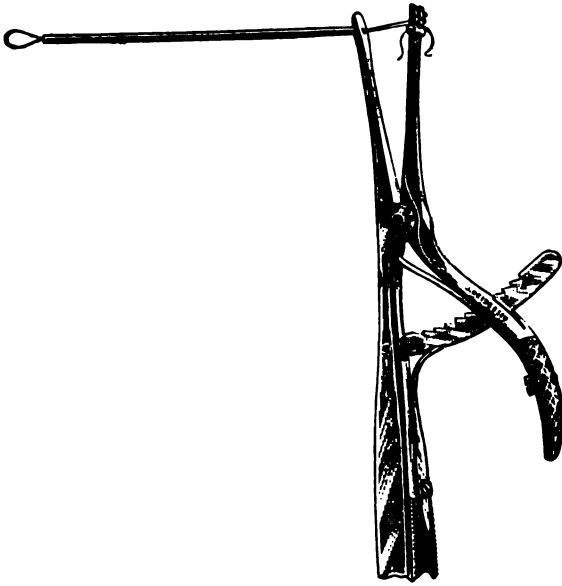


Fig. 651.—Snare for Aural Polypus

had better be previously soaked in a 20 per cent. solution of cocaine. Before applying the caustic, some operators lacerate the tissue of the growth with fine forceps. The finely-pointed galvano-cautery may be used if the operator has complete confidence in the steadiness of his manipulations. Finally, it may be added that the method of rotation has been applied to large pedunculated polypi; the growth being twisted on its axis a certain number of times, will come away at the time or a few days afterwards.

After treatment.—The patient should remain indoors and be kept warm; and for at least some months after the removal of an

aural polypus, careful attention should be paid to the cleansing of the ear, and especially to the repeated destruction of any re-appearance of the growth by caustics. These formations will certainly recur unless great care is taken in the after-treatment.

Treatment of granulations.—This may be inferred from the preceding paragraphs. Fine curettes and the escharotics are especially useful, but from the presence of carious bone, and the likelihood of cerebral complications, such cases must be approached with peculiar caution. The advisability of performing mastoid antrectomy should always be considered. After free drainage these growths will shrink in a remarkable manner.

Tinnitus aurium.—This is a common aural sensation familiar to most of us. It varies in character, and is usually compared by patients to noises frequently heard by them, as the boiling of a kettle, rustling of wind through trees, sounding of bells, and the like. The **causation** is often quite obscure. In one class of cases the tinnitus is associated with some evident disease of the ear, as impacted wax or chronic middle ear catarrh, with retraction of the drum and inward pressure of the stapes on the endolymph. It may follow large doses of quinine or salicin. In another class of cases the symptom is connected with some alterations in the conditions of the blood or vessels: as anæmia, Bright's disease, cardiac mischief, or intra-cranial aneurysm. In yet another and final class the symptom is largely psychical, and associated with shock, fright, or especially mental worry. To this class belong also the "voices" heard by the insane.

In the **treatment** of this distressing malady, the indications to be observed are first to discover and treat any conditions of the ear, nose, or naso-pharynx, that could possibly produce the tinnitus, and failing this to deal with any constitutional defect that may be present. The bromides with camphor mixture are often useful, hydrobromic acid in full doses has been lauded, and so has a powder composed of small doses of quinine and morphia. Galvanism will occasionally relieve cases associated with chronic middle ear deafness. In desperate instances, when the membrane is retracted, when the tubes are obstructed, and when mechanical pressure upon the stapes is unduly exerted, the drum has been excised, or a free opening made in it with the galvano-cautery. Cases are recorded by American writers, showing marked relief after excision of the drum to remove mechanical pressure. Lastly, in incurable cases, and they are not a few, the patient may be consoled with the reflection that time will usually ameliorate his condition.

Diseases of the auditory nerve and perceptive apparatus.

Causation.—It may be stated at the outset that these affections are rare as compared with affections of the external and middle ear. The pathology of them is often ill understood, but the nervous apparatus of the internal ear is liable, like the retina, to damage from hæmorrhage and inflammatory exudations. Congenital deficiency is found in some cases, and tumours at the base of

the brain near the corpora quadrigemina may cause bilateral nerve deafness. The auditory nerve may also be damaged in its distribution by basal meningitis, new growths, or gross injury, as fracture of the base of skull. In a certain number of cases nerve deafness may follow shock, as a great fright, or grief, or personal calamity. Anæmic women, exhausted by pregnancies and suckling, not infrequently suffer from nerve deafness, and this condition, like other obscure nervous maladies, is present in hysteria. A certain number of women become deaf at the period of the menopause. In a considerable number of cases no distinct cause can be traced. Nerve deafness, due to hæmorrhage or inflammatory effusions, is found in syphilis, acquired or congenital, after the specific fevers, especially mumps, and in chronic Bright's disease and hæmorrhagic affections dependent upon vascular degeneration. "Concussions" of the labyrinth may also produce auditory nerve degeneration, and this explains the nerve deafness of boiler-makers, deafness after the explosion of heavy guns, and the like. Nerve deafness may also be caused by advanced disease of the middle ear, as perforative otorrhœa, the morbid processes spreading inwards.

Diagnosis.—Nerve deafness due to syphilis is generally associated with other evidences of that malady, congenital or acquired, which should always be looked for in these cases. Nerve deafness is usually sudden in onset; the patient hears worse in a noise, best in a quiet room. The early symptoms of the affection may be associated with vomiting and intense cerebral pain and vertigo, a group of symptoms to which the term *Menière's disease* has often been loosely applied. Above all things, a large tuning-fork is not heard through the cranial bones, or if at all, feebly, and the fork may be heard at the meatus after it has ceased to be heard upon the bones of the head. These symptoms, if certainly present, point undoubtedly to nerve lesion. In cases where a patient is so deaf that he cannot hear even by shouting against the ear, nerve deafness is generally present.

Treatment.—It is obvious that the treatment of auditory nerve deafness belongs largely to the domain of general medicine, and whether any treatment should be instituted, or of what nature, depends largely on the estimate the surgeon forms of the pathological conditions present.

As a general rule, all treatment is very unsatisfactory. Electricity has been much vaunted, but appears to be of little real use. The nerve deafness of acquired syphilis is more hopeful, and in such cases the subcutaneous injection of pilocarpine will sometimes prove of benefit. Politzer, who first drew attention to this remedy, points out that it is only of use in cases of nerve deafness. The drug probably acts by causing exudation of serum from the vessels, and promoting tissue change, but its real clinical value is extremely limited. Some few cases of labyrinthine deafness from other causes seem also to improve under this remedy. One-tenth grain may be injected subcutaneously under the skin of the arm once a day, and the dose be gradually increased to $\frac{1}{8}$ or $\frac{1}{4}$ grain. During the salivation,

diaphoresis, and temporary exhaustion which may follow, the patient should lie down and be well covered with rugs or blankets. The nerve deafness of congenital syphilis is, in my experience, always incurable. Some cases of nerve deafness in syphilis are due to the pressure of inflammatory exudation on the larger terminal twigs of the auditory nerve. Facial paralysis may then co-exist. Such cases may improve under mercury and the "iodides."

Deaf mutism.—Deaf mutes arrange themselves into two classes :—(1) Those who have never learned to use articulate language; (2) those who have learned to speak, but who having been afterwards rendered deaf, have rapidly forgotten the art. In the examination of these cases much pains and attention should be bestowed, and it is well to examine them at intervals on different occasions before pronouncing a definite opinion.

In connection with the first class may be mentioned congenital imperfections, frequently the result of marriages of consanguinity, and that want of cerebral development which is best exemplified in the lower classes of idiots.

In the second class may be noticed deafness from scarlatinous otitis media and especially hereditary syphilis. It is astonishing how soon a young child, rendered deaf, loses the power of speech, and in such, early education by the "lip method" should at once be undertaken. The details cannot here be explained. The time taken will depend upon the child's intelligence, and the age he is entered for instruction. Five to seven years is no uncommon period, but the results usually well repay the trouble bestowed.

Hysterical and feigned deafness.—Deafness is occasionally complained of by hysterical girls, and will be diagnosed by the absence of any signs of organic disease, and the concomitant symptoms of hysteria. In these cases the tuning-fork tests are seldom answered intelligibly, and time usually clears up the true nature of the case. The same doubts arise in these cases in diagnosing hysteria from real disease, that occur in other circumstances. The hearing usually returns as suddenly as the patient declares it was lost. Feigned deafness is not uncommon in those seeking compensation after accidents, and in soldiers who wish to obtain discharge. Bilateral feigned deafness is exceedingly difficult to detect, and the tuning-fork test will prove the best guide. Simulated unilateral deafness is more easy to recognise. Among the many methods advocated, one may especially be mentioned. A bin-aural stethoscope is applied to the patient's ears, and the tube leading to the sound ear is blocked privately with wood. A sentence is now whispered into the cup, and the patient is requested to write down the words he hears. If he asserts that he hears nothing his case is probably genuine. Supposing he asserts that he hears the sentence or part of it, the tube is now removed from the sound ear, and the patient made to block the canal with his finger. The sentence is again whispered into the cup, when the malingerer will declare he hears nothing, as the tube he supposed he heard with before is removed.

Few malingerers are aware that in middle ear deafness the fork is heard best on the deaf side—and by repeated tests, such contradictory statements are arrived at that grave suspicion is raised. These cases are, however, often very complex, and demand the most repeated and careful examination before giving evidence regarding them in a court of law.

Apparatus for improving hearing.—All “ear trumpets,” “acoustic tubes,” and other apparatus are quite useless in cases of nerve deafness. As a rule, if the sounds of a large fork can be well heard through the bones, an ear trumpet will improve the defect. The smaller and more inconspicuous the trumpet, the less is its practical utility. Instruments like the “audiphone” are more interesting physiologically than useful surgically. In cases of incurable middle ear deafness—and they are not few—the patient should apply to a surgical instrument maker of repute, and be fitted with that form of trumpet which, after comparative experiment, seems to suit his case best. He should avoid advertised appliances, which are generally inferior, always costly, and sometimes harmful.

XLII. DISEASES OF THE NOSE.

By A. MARMADUKE SHEILD, M.B. CANTAB., F.R.C.S.,

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Anterior rhinoscopy.—A good light is essential for the proper examination of the nose. Bright daylight, or the rays from a powerful lamp, may be reflected into the nares from a forehead mirror, or a small electric lamp may be fixed by a band upon the forehead of the surgeon. The patient being seated in a chair, the observer tilts up the end of the nose with the thumb of the left hand, and as the head of the patient falls backwards, he inspects the septum and the inferior meatus. By inclining the head laterally, the inferior turbinated bone may be well brought into view and also the anterior end of the middle turbinal. A nasal speculum (Figs. 652 and 653) may now be introduced, and the examination repeated, any discharge being carefully mopped away with pledgets of wool twisted upon a probe, and its nature, apparent source, and morbid odour carefully observed. In this way, using a good light, and especially by inclining the head of the patient in different directions, a good view of the inferior meatus, the septum, the lower turbinal, and the greater part of the middle turbinal is obtained. In roomy noses, with full dilatation and a good light, the inferior meatus may be illuminated so that the back of the pharynx comes into view. More than this the examiner may not certainly see. Examination is much facilitated by spraying a little 5 per cent. solution of cocaine into the nares. This causes shrinkage of the mucous membrane over the turbinals, especially when it is morbidly hyperæmic or swollen. Before leaving the subject of anterior rhinoscopy, it may be mentioned that it is of the utmost importance for the observer to be acquainted



Fig. 652. — Fraenkel's Nasal Speculum.

with the appearance of the interior of the nares in those who suffer from no symptoms of nasal disease. He will be surprised at the diversities in size and formation of the lower turbinal, and at the frequency of septal deformities, in persons who suffer no inconvenience whatever from such conditions.



Fig. 653.—Duplay's Nasal Speculum.

Posterior rhinoscopy.—Examination of the posterior nares with a mirror is more difficult than anterior rhinoscopy, and in children and nervous persons is frequently impossible. Momentary glimpses of the parts are indeed obtained, but observations founded on these are exceedingly likely to lead to erroneous diagnosis. In cases where an accurate examination is of great importance, as in some cases of naso-pharyngeal polypus, the palate should be cocaineised and drawn well forwards by means of a flat elastic band, passed in the eye of a soft (Jacques) catheter through the inferior meatus into the pharynx, and tied in a knot over the upper lip.

Several examinations are often advantageous in important cases.

The rhinoscopic mirrors should be of different sizes and shapes, and if they are movable on the handle so that the angle of the mirror admits of alteration it will be convenient (Fig. 654). The tongue should be depressed downwards and forwards, and the mirror slipped into the space between the uvula and the right faucial pillar. Touching the base of the tongue, the uvula, or the pharynx, is certain to excite retching and movements of the palate. The parts seen on a successful examination are the posterior extremities of the middle and lower turbinals, the middle meatus, the vault of the pharynx, and the fossa of Rosenmüller, with the orifices of the Eustachian tubes (Fig. 655).

Exploration by the finger.—The finger passed behind the soft palate, under anæsthesia or the cocaine spray, will often give more accurate information than the rhinoscope. The exact connections of a tumour can be thus well explored, a small polypus detected, the existence of adenoid growths verified, and undue hypertrophy of the posterior extremities of the turbinals easily diagnosed by the educated finger.

Transillumination.—If a powerful electric lamp (Heyring's) be held in the shut mouth in a dark room, a remarkable translucency of the bones of the face is produced. This method is especially of use in the diagnosis of antral empyema, which often produces a flow of yellow pus from one nostril. When the lamp is held within the margin of the orbit, the frontal sinuses are illuminated, but in the cases I have observed, to a slight extent. The bones of the face are so thick in certain individuals, that

illumination is very feeble. I have known opacity shown, when no pus was found on exploration. (See p. 926, Vol. I.) At present, transillumination may be looked upon as a diagnostic aid in cases of supposed disease of the frontal sinus or antrum. It can scarcely be certainly relied upon.

Injuries of the nose.—*Wounds* of the nose present nothing

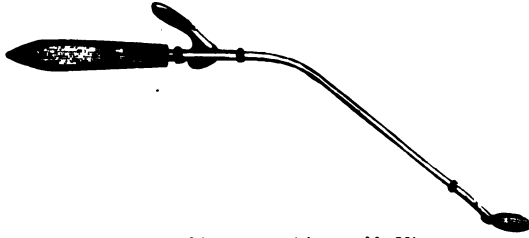


Fig. 654.—Rhinoscope, with movable Mirror.

special. When portions of the organ are extensively detached, they should never be cut away. Accurate adjustment with fine horsehair or silkworm-gut sutures is very essential, and speedy union occurs. Wounds of the roof of the nasal fossæ by pointed instruments are of extreme importance, on account of the ease with which they may be overlooked in accidental or homicidal cases, and the frequent implication of the venous sinuses, meninges or brain, in fatal septic inflammation.

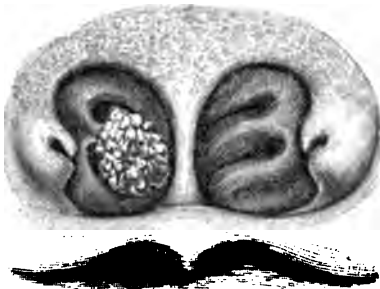


Fig. 655.—Parts seen in Posterior Rhinoscopy, with a Hypertrophic Growth on the Middle Turbinal.

Complete removal of the nose, a mutilation still practised among savage tribes, needs one of the operations included under the term rhinoplasty.

Fractures of the nose are common, especially in children, and may involve the nasal bones or the septum, and in some cases the

fracture may extend across the anterior fossa of the base of the skull, or into the superior maxillary bones. It is of importance carefully to examine any case of supposed fracture at the time of the accident, under anaesthesia, and rectify any deformity or displacement of the septum that may have occurred. The nostrils may then be plugged with rolls of oiled lint, or splints should be worn (Fig. 656), until union has taken place. A well-moulded external splint of sheet lead is often useful in these cases, and so is guttapercha fitted round the head and down over the nose. The bones can usually be levered into position with the fingers or flat-bladed forceps, without

incising the external parts. Many troublesome deformities of the nose in adults are due to neglect of a "broken nose" in early childhood, and this subject demands the most careful attention of every practitioner.

Epistaxis.—Hæmorrhage from the nose is exceedingly common, and should always, unless in extremely urgent cases, be looked upon as a symptom, the cause of which is to be ascertained before treatment is instituted.

The student must remember that blood, especially when small in amount, will pass through the posterior nares, and being swallowed and vomited, or passed per anum, may simulate serious disease of the stomach or intestinal tract, or produce a progressive anæmia hard otherwise to explain. The "coughing up" and expectoration of clots of dark venous blood should always lead to a careful examination of the pharynx and nose, especially when clots of a like nature are seen hanging about the turbinals. This points strongly to a nasal cause for the bleeding.

The principal causes of epistaxis may be enumerated as follows:—

(1) Injuries, as surgical operations, blows on the nose, or fracture of the base of the skull. Impacted rough foreign bodies.

(2) Ulcerations in syphilis, tuberculosis, glanders, or perforating ulcer of the septum, and especially a small ulcer forming from irritation on the projection of a deformed septum. This may be a mere erosion opening into a vein, and is very likely to be overlooked. An erosion on the septum nasi is a most important cause of obstinate epistaxis.

(3) Congestions, alterations in the blood or vessels. This comprises a very large class. Here we may especially mention cirrhosis of the liver, the congestion of pneumonia, the early and "critical" stages of fevers, obstructive mitral disease, alcoholic plethora, mechanical obstruction from thoracic aneurysm and other tumours and the epistaxis of intense dyspnœa, as in "whooping cough." In many of these cases the epistaxis is distinctly salutary, and should not be checked. Hæmorrhage from degeneration of the vessels is found in atheroma and the various forms of Bright's disease, epistaxis from altered conditions of the blood in such affections as purpura, pernicious anæmia, and leucocythæmia. In the hæmorrhagic diathesis repeated epistaxis is common.

(4) Vicarious menstruation. This is more rare than is generally supposed, yet cases are related which seem to place its occurrence beyond doubt.

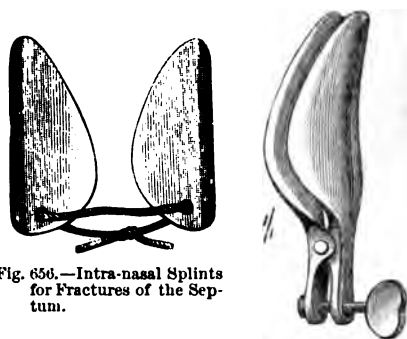


Fig. 656.—Intra-nasal Splints for Fractures of the Septum.

(5) New growths. In this important class must especially be placed sarcomatous polypus, whether firm and fibrous, or soft and fungating. The so-called fibrous tumour of the naso-pharynx is in most cases a periosteal spindle-celled sarcoma, and the hæmorrhage from this form of growth is so repeated and persistent as to lead to anæmia, and to form a significant symptom of the disease. Epithe-

lioma, whether cylindrical or squamous, may give rise to epistaxis, and so may nævoid growths; but bleeding is very rare in gelatinous polypus, unless the growth has been lacerated by instruments.

Diagnosis of cause.—Unilateral epistaxis is probably due to a local cause. Bilateral epistaxis, or alternate bleeding from either nostril, indicates a constitutional cause, and in many of these cases such symptoms as headache, or a general feeling of discomfort, relieved by the bleeding, are common. The source of dark-coloured blood is usually from a septal vein, while arterial epistaxis is very significant of a sarcomatous growth. Many sufferers from repeated and severe epistaxis are obviously the sub-

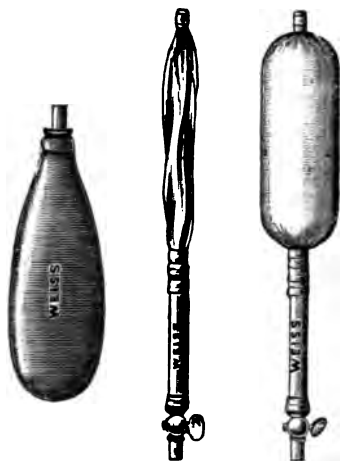


Fig. 657.—Cooper Rose's inflatable intra-nasal Tampon for Epistaxis.

jects of one of the above-mentioned constitutional diseases, which come under the care of the physician. In such cases it is not always wise to arrest the bleeding. Epistaxis in aged people, the subjects of vascular degeneration, is often a precursor of intra-cranial or intra-ocular hæmorrhage. Blood and discharge passing from one nostril usually point to ulceration or necrosis, and in children to the presence of a foreign body. Difficult cases for diagnosis are those where the bleeding is repeated, small in amount, and the blood trickles down the pharynx. In such too much care cannot be exercised in local examination, and a small erosion opening into a vein will frequently be detected. The bleeding may often be "started" and its source ascertained by stroking over the mucous membrane of the septum with a tiny sponge on a probe.

Treatment.—Slight epistaxis may be treated by the familiar remedies of cold, syringing with iced water, or the application of an ice-bag to the spine. On the other hand, the syringing and external application of hot water have also proved efficacious. Plugging the nares is often resorted to quite needlessly, and if the following method be adopted, the surgeon will seldom have recourse to it. The patient should be kept in a sitting position, if possible, before an open window, and the feet and legs may be placed in warm water, or wrapped in hot cloths. Digital pressure may be applied at the same

time to the facial arteries, or an elastic band passed round the head, over the upper lip, and under the occiput. This is a valuable and simple adjunct, and in combination with position will usually prove efficacious. In cases of repeated epistaxis from congestive conditions, free watery purgation is very efficacious. Drugs which tend to constrict the smaller vessels, as ergot and digitalis, will often be indicated. The use of a 10 per cent. cocaine spray is advisable. This remedy constricts the vessels, and facilitates local examination. Astringents should be applied, if possible, to the bleeding spot itself by means of a probe and cotton-wool. Turpentine, hamamelis, tannic acid, or the iron solutions may be used in this way, but powerful astringents should never be applied carelessly to the general surface of the nasal cavities. Disastrous results have followed this practice. *Plugging the nares* will become needful only in very bad cases, and this proceeding is best carried out by the indiarubber tampon, carried into position by forceps (Fig. 657). When this is not obtainable, the nares must be plugged by the aid of a soft Jacques catheter or Bellocq's sound (Fig. 658). The former instrument is infinitely preferable as being soft and comfortable to the patient. An opening like the eye of a needle being made at the end of the catheter, this is threaded with a long piece of soft strong silk. The instrument is passed rapidly along the floor of the nares, and pushed onwards until its point appears behind the soft palate. The flexible catheter is readily seized with forceps, and brought into the mouth, when the silk can be secured and the instrument withdrawn, leaving a loop of silk hanging out of the mouth, and a double thread from the nostril. A soft Turkey sponge of appropriate size, well impregnated with powdered boric acid, is now tied upon the silk, and manipulated into position with the forefinger, and by traction through the nostril. A similar piece of sponge is passed well into the anterior nares, and the double silk firmly tied over it. Finally, the loop of silk from the mouth and the two ends from the nostril can be loosely attached at the angle of the mouth for purposes of ultimate withdrawal. The plugs soon get foul, and it is seldom advisable to allow them to remain after the second day. The greatest stress is laid on the impregnation of the sponges with boric acid, and the avoidance of strong and caustic astringents. The practice of placing a plug steeped in perchloride of iron in the posterior nares is responsible for many cases of purulent otitis media. In removing the plugs, it is well thoroughly to loosen them before withdrawal, by warm syringing with boric acid lotion.

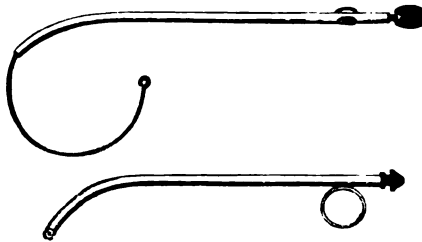


Fig. 658.—Bellocq's Sound.

Foreign bodies in the nose.—All kinds of materials may be pushed into the nose by children, hysterical subjects, and lunatics ; and in such patients a unilateral purulent nasal discharge will generally point to a foreign body. Among common substances introduced may be mentioned buttons, pebbles, glass beads, fruit stones, beans or peas, pieces of paper, or an extracted temporary tooth. Splinters of wood or metal may gain access to the nose or its accessory sinuses in severe injuries of the face, as those caused by the bursting of a gun ; and great care should be exercised in the examination of the deeper parts of such wounds with the finger, before the soft parts are united. Vomited matters—as pieces of meat or fruit—may enter the nose posteriorly, and in this way a round worm (*ascaris lumbricoides*) has been removed from the nares.

Lastly, maggots have been found in the nasal cavities, especially in cases of *ozena* and necrosis. This disgusting complication is not common in England. The symptoms in related cases seem to have been exceedingly severe, and included agonising pain, profuse bloody and purulent discharge, severe cellular inflammation, with formation of abscess and sinus, destruction of the eyes, and even death from meningitis.

Rhinoliths.—With foreign bodies may conveniently be considered rhinoliths. These formations vary in size, shape, and consistence, but are usually, when cleaned, of phosphatic appearance, almond-shaped, white in colour or covered with altered blood, and slightly tuberculated and rough on the surface. They are composed of the saline constituents of the nasal discharge, chlorides and carbonates of sodium and potassium, phosphates and carbonates of calcium. Usually a small foreign body, as the testa of a bean or pea, forms the nucleus. When of very large size, rhinoliths have been known to cause nasal deformity, epiphora, and severe neuralgia.

Diagnosis.—The history of foreign bodies in the nose is seldom conclusive, and in children is generally absent. Such symptoms as unilateral nasal discharge, severe neuralgia, or epiphora and external deformity, should lead to a thorough examination of the nose. In children anaesthesia is needful, and the offending substance may be felt, if not seen. Rhinoliths, or pieces of necrosed bone, may be diagnosed by the rough sensation given to the probe. Most foreign bodies are found in the inferior meatus, and are easily visible anteriorly on full illumination.

Treatment.—Removal is always indicated, and the appropriate instruments, as small scoops, forceps, and blunt hooks, need careful selection for each individual case. Anaesthetics are generally essential, and the parts should be well dilated and illuminated. When the foreign body is not visible, manipulation by the left forefinger in the posterior nares, with the forceps or scoop anteriorly, is often effectual. The offending substance may be pushed into the naso-pharynx, but great care should be taken that it does not then fall into the air-passages of an unconscious patient. Rhinoliths, when of large size, may necessitate crushing before extraction, with powerful forceps, and in some cases

external incision has been practised. In the treatment of parasites, the free use of chloroform, both in the form of vapour and also in dilute solution, has been found efficacious, and this may be associated with mechanical dislodgment by powerful syringing with warm solutions of carbolic acid or perchloride of mercury. In all manipulations of instruments within the nose, peculiar caution as to care and gentleness should be used, especially near the roof of the nasal fossæ.

Ozæna.—By the term ozæna is understood a discharge from the nose, associated with an offensive odour. The amount of discharge and its nature, and the intensity and quality of the odour, vary greatly, and careful attention to these considerations may afford a clue to the causation of the symptom. The odour of most cases of bad and typical ozæna is of a peculiar musty nature, which, when once recognised, is not easily forgotten. It renders the patient an object of disgust to those around him, and prevents him from getting any employment or occupation.

Causation and pathology.—It is obvious that any nasal discharge may have some amount of disagreeable odour. If the term "ozæna" be loosely employed, such causes of purulent discharge from the nose as ulcerations from foreign bodies, syphilis, abscess of the accessory sinuses, or alveolar abscess about the roots of the upper incisors, bursting on the floor of the nose, may receive mention. In the majority of such cases the patient is very conscious of the disgusting odour, for his sense of smell is not lost.

Instances where the fœtor is very abominable, rendering the patient an object of dislike to those about him, to which alone the term ozæna should be applied, are usually caused by two conditions. The first is a diseased state of the nasal mucous membrane, associated with deficient secretion, collection of crusts, and inspissated discharge. The other is the presence of deep ulceration, especially when associated with necrosis of bone or cartilage, in acquired or congenital syphilis, or after injuries in tuberculous subjects. The worst examples of ozæna are associated with the first cause, and it is a great error to suppose that bone disease is present in all these cases, which is the common assumption. The condition of the nasal mucous membrane above spoken of is peculiar, and the true pathology of it obscure. The essential changes in the lining membrane that have been described in this disease (*atrophic rhinitis*) may be thus summarised. Fatty degeneration and atrophy of the surface and gland epithelium, and finally, also of the glands themselves. Increase of connective tissue with shrinkage and obliteration of the venous channels. Diminution of serous exudation and collection of inspissated crusts in consequence. The greatest difference of opinion exists among authors as to the commencement of this affection. Most are agreed that it is the later stage of a catarrhal process, associated with purulent discharge and desquamation of the epithelium. Atrophic rhinitis may

thus be a sequel of the purulent rhinitis of dirty and ill-nourished children. Micro-organisms have been described by Löwenberg and others, but it is obvious that in such a malady they may be associates rather than originators of it. The well-known offensive odour of certain organisms, as *bacillus fetidus*, is, however, very significant in this connection (p. 12, Vol. I.). The affection is often termed "strumous," but with hardly sufficient reason, though it is of frequent occurrence in poor and delicate children. On the other hand, I have seen typical cases in healthy country people, where there was no evidence either of syphilis or tuberculosis. The subjects of it have usually flattened noses and wide nares; it is seldom met with in those who have well-arched noses. It seems generally agreed that the atrophic state of the membrane and of the glands so diminishes the serous exudation as to lead to inspissation of the discharge, and to cause it to hang about the nasal cavities in stinking masses of greenish adherent crusts, which may subsequently erode the subjacent atrophic membrane, and are peculiarly diagnostic. The naso-pharynx is also dry and glazed, and greenish adherent crusts of the same nature may be seen in this situation. Chronic laryngitis has been noted in some cases, and also chronic catarrh of the middle ear. The general health is usually below par, the patients being pale, depressed, and anæmic. Complete anosmia is commonly present.

Ozæna connected with necrosis, especially syphilitic necrosis, is associated with a more profuse yellow discharge than we find in atrophic rhinitis. The odour is, if possible, more penetrating and nauseating, but is yet of somewhat a different nature; deep ulcers and necrosed bone can generally be detected on examination, and these may be covered with black adherent crusts.

Treatment.—The indications to be observed in the treatment of ozæna are as follows: (1) Remove any local condition that may cause the disease, as foreign bodies, masses of necrosed bone, or disintegrating soft tissues, masses of crusts and inspissated secretion. (2) Carry out disinfection and cleanliness of the nasal cavities. (3) Apply remedies to the diseased mucous membrane, and attend carefully to the general health and dietary. (4) Treat any constitutional diathesis that may be present.

Definite cure of ozæna is only to be hoped for when the cause can be thoroughly removed, and the most favourable results will therefore follow the abstraction of a loose sequestrum, foreign body, or rhinolith, and the ordinary constitutional and local treatment for syphilis. In the ozæna of atrophic rhinitis it is doubtful if a definite cure can be promised, but it is certain that such amelioration of the symptoms can be brought about as to place the patient in comparative comfort. The severity of this malady is also much lessened by the advance of age. Local treatment must be most carefully and thoroughly carried out, if needful by the surgeon himself. The loosening and removal of the crusts is best effected by the use of the nasal douche (Fig. 659), or spray containing a warm dilute

alkaline and disinfectant lotion. In this way solutions of chlorinated soda, borax, carbonate of soda, and chloride of sodium may be used, combined with carbolic acid. The combinations thus effected and the drugs used may be numerous, but the method and thoroughness with which they are applied is of far more importance than is generally supposed. Many of the stinking crusts will loosen and come away, and any that remain must be mechanically removed by scoop or forceps. When the cavities are cleared, an antiseptic lotion, dilute and warmed, may be used to the nose with a syphon douche night and morning. The local remedies applied to the diseased mucous surfaces, in the forms of snuffs, sprays, and ointments, are numerous, but I will only draw attention to the excellent results that may be obtained in these cases by packing the cleared cavities with small pledgets of soft wool impregnated with a vaseline or lanoline ointment combined with iodoform, boric acid, or eucalyptus oil. Any antiseptic remedy may be thus employed, and can be brought in direct contact with the mucous membrane. The pledgets of wool may be tied upon fine soft silk, after the fashion of a kite-tail. Such local measures, combined with appropriate constitutional treatment, will usually greatly improve these distressing cases.

Few of these patients, however, can dispense with the daily use of the warm antiseptic douche. Removal of the mucous membrane by the vigorous use of a curette has also been advised. Considering the septic state of the nasal cavities, such treatment would be attended with risk. The methods of applying solutions to the nasal cavities are many. The douche constructed and used on the syphon principle is, perhaps, the most efficacious. I always insist that the tubing should be passed far backwards along the floor of the nose, and that undue pressure of the fluid by raising the receptacle to a great height should be avoided, otherwise fluids or discharges may be forced into the middle ear, causing inflammatory consequences. A good rough method of using lotions is to instruct the patient to fill the hollow of the hand, and draw up the solution through the nose, at the same time that the head is thrown backwards.



Fig. 659.—Syphon Douche.

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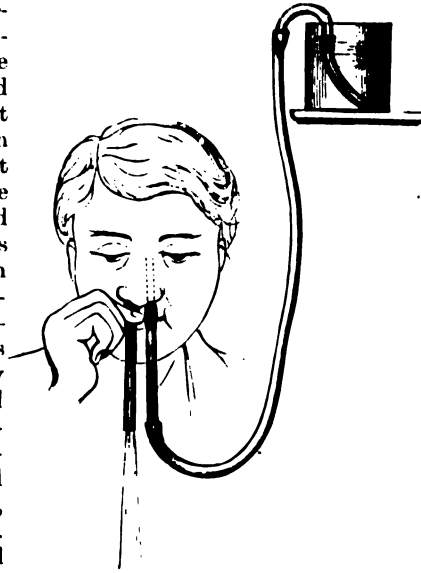


Fig. 659. - Syphon Douche.

Caries and necrosis. Causes.—Caries and necrosis of the bones of the nose may well be considered after that of ozæna, of which affection it is one of the most important causes. Syphilis, whether acquired or congenital, is the leading originator of nasal necrosis, especially of the ethmoid or septum. More rarely these cases are tuberculous, or due to the emanations of phosphorus; some follow scarlet fever or measles, and a few are the result of traumatism. Here we must mention the necrosis that sometimes follows intra-nasal operations, as the forceps operation for polypus, or the too free applications of powerful caustics and the cautery. Intra-nasal necrosis is always significant of a bad type of syphilis, and is found in neglected cases and in severe forms of this disease originating in new countries. None of the bones of the nose are exempt from the ravages of gummatous periostitis, with deep ulceration and destruction. The septum may be entirely destroyed, the nasal bones disintegrated, or large sequestra may separate from the body, wings, or pterygoid plates of the sphenoid. The nose may thus undergo the familiar depressed deformities associated with destruction of the septum, and the general health severely suffer, while implication of the meninges or brain by suppurative meningitis is not unknown. It has been stated that necrosis of the ethmoid is associated with the growth of nasal polypi, but this matter is too controversial to be here dealt with. Necrosis about the ethmoid is certainly found after "the forceps operation" for polypus, or the application of the cautery high up the nose. Some cases of intra-nasal necrosis are vague and dubious as regards origin, and it will ever be remembered that an unsuspected sequestrum in the nose may be an important cause of trigeminal neuralgia. The nasal cavities should always be carefully examined in these cases. Necrosed bone in the nose, surrounded by granulations, closely simulates malignant growths.

Treatment.—The treatment already indicated for ozæna should be carried out, and removal of the dead bone effected. It is often difficult to detect small foci of caries, and a methodical examination with probes of different shapes and sizes is always advisable. As a matter of prudence, it is wise not vigorously to attack necrosed bone towards the roof of the nose, unless there is a loose sequestrum, which may readily be removed by moderate traction. The gentle and cautious use of small curettes is permissible, the cavities being afterwards filled with finely-powdered iodol or boric acid. In many severe cases of intra-nasal necrosis, it may be needful to give access to the cavities by dividing the soft parts laterally, but necrosis about the higher accessory sinuses is seldom amenable to treatment.

Numerous operations have been devised, but among them may especially be mentioned the *method of Rouge*. Here a free incision through the mucous membrane at the junction of the upper lip with the maxilla permits the upper lip and the cartilages of the nose to be bodily turned upwards, and permits of free access to the bony nasal cavities. Median and lateral incisions may be

made to obtain access to the nose, and the whole organ may bodily be turned upwards on the forehead, by dividing the cartilages and the articulations of the nasal bones with the maxilla, by means of fine cutting forceps. Union is afterwards rapid and satisfactory, if the parts be accurately adjusted. In all these operations the aid of a highly-skilled anæsthetist is needful, and if the posterior nares be, as a preliminary, well plugged with sponge, much of the danger, delay, and nuisance caused by blood flowing into the air-passages will be avoided. In necrosis near the roof of the nose, if operation is contra-indicated the greater care should be taken to flush out the nares at least twice daily with warm antiseptic solutions.

Hypertrophy of the mucous membrane, hypertrophic rhinitis.—

This common affection is responsible for many cases of intra-nasal discomforts, as anosmia, a sense of obstruction shifting from one side to the other, attacks of sneezing, and especially profuse mucous discharge, which saturates many handkerchiefs, and hangs about the naso-pharynx causing morning "hawking and

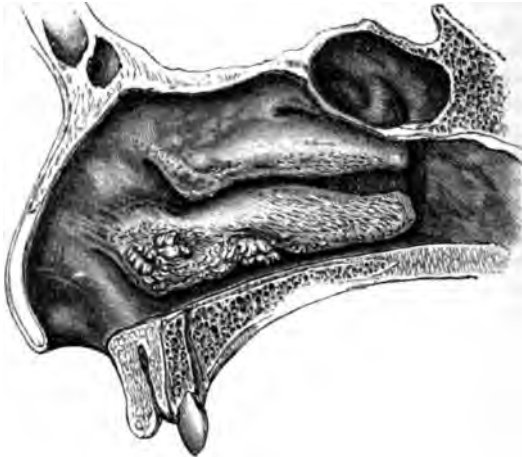


Fig. 660.—Hypertrophic Rhinitis, with Polypoid Vegetations over the Lower Turbinal.

spitting." Not infrequently chronic deafness supervenes in these cases with tinnitus aurium. The parts affected are especially the mucous membrane over the middle and lower turbinals (Fig. 660). At the anterior extremity of the lower turbinal will frequently be seen a pinkish soft enlargement the size of a grape, often mistaken for polypus, but differing from that affection in being sessile and not moving to the probe. True mucous polypi and adenoid growths of the naso-pharynx are often associated with this disease. The mucous membrane along the outer wall of the nose is obviously swollen and thickened, and of a gelatinous appearance and grey colour. The enlargement usually shrinks markedly under cocaine, the application of which drug is a diagnostic aid and gives great temporary relief. Considerable masses of hypertrophied tissue may form in like manner over the posterior ends of the turbinals. The sufferers from this affection are not uncommonly individuals of neurotic type. They suffer from a perpetual "cold in the head," and

may be liable in the summer to attacks of "hay fever." I have seen many cases in neurotic girls at the age of puberty. Asthma is found in a certain proportion of them, with a tendency to severe headaches, disturbances of vision, and even, it is asserted, epilepsy. They are usually mouth breathers, and snore at nights. Many of the so-called "reflex phenomena," described as associated with this form of nasal disease, will, however, hardly find acceptance with those who are well acquainted with general pathology.

Causation and pathology.—Most authors believe that hypertrophic rhinitis is the result of repeated attacks of inflammation due to cold or irritating vapours, dust, pollen, tobacco smoke, and the like. Bosworth especially holds to the view that numerous cases are associated with nasal stenosis from septal and other deformities. In such conditions, he asserts, a negative pressure is exerted on inspiration in certain parts of the mucous membrane, which hence becomes unduly hyperæmic, and finally hypertrophic. From its enormous vascularity and the frequent variations in circulation the nasal mucous membrane is certainly prone to chronic inflammatory processes. The essential structural changes described by authors are hypertrophy of the structures of the whole membrane, epithelium, glands, adenoid tissue, and connective tissue. Distinct myxomatous change is found in the connective tissue, and the structure of the protuberant masses at the ends of the turbinals is very similar to that of mucous polypi. The proper filtration of serum and mucus from the vessels and glands being interfered with, the tissues get "sodden" with these products, and hence the swelling and discomfort vary with the variations of vascularity, and with the presence or absence of causes that aggravate the disease.

Treatment.—Residence in pure dry air, absence of nerve worry and anxiety, good food and tonics, especially arsenic, materially benefit these cases. Astringent washes applied with spray or syringe are very useful. The salts of zinc or lead may be employed in this way, and can be combined with carbonate of soda, carbolic acid, or vaseline. I think that solutions are preferable to "snuffs" in these cases. Such remedies as camphor, menthol, tannin, and bismuth, with small quantities of morphia, are recommended as snuffs by excellent authorities. A spray of 5 per cent. solution of cocaine gives great relief, but there are obvious objections to the constant use of cocaine by patients, and sooner or later it loses its good effects. In bad cases, where great hypertrophy of tissue is evident, operative treatment is needful. Protuberant masses at the ends of the turbinals may be removed by a small *écraseur* with cold steel wire. The plan of transfixing the masses with a fine needle on a handle and applying the wire loop above it (Jarvis), is very convenient. The swollen membrane over the turbinals may conveniently be subjected to linear scarification under cocaine with the galvano-cautery, or some powerful caustic may be lightly applied, as chromic acid, nitrate of silver, or perchloride of iron. The application of the galvano-cautery is preferable, and the resulting cicatrization

benefits these cases considerably (Fig. 661). Masses of hypertrophied tissue at the back of the turbinals are difficult to remove, and troublesome bleeding may ensue. Under anæsthesia a fine *écraseur* may be passed through the anterior nares, and a stiff steel wire loop manipulated round the protuberance, which is then slowly severed. Some operators prefer to use a ring-knife. I have treated several of these cases with good success by scraping the tissue away with the artificial steel "nail" and a sharp-curved curette. The galvano-cautery may also be employed, being guided to the mass by the finger in the pharynx. The throat and pharynx are frequently affected in these cases, the back of the pharynx being "granular," with hypertrophy of its numerous mucous follicles. This condition calls for appropriate treatment.

It is a common practice to remove the inferior turbinal in cases of hypertrophic rhinitis. As the disease is essentially one of the mucous membrane rather than of the bone, I venture to think that such operations are not needful, unless in cases of great malformation and hypertrophy of the bones themselves, or the development in them of cysts, a rare condition.

Hay fever.—This term is open to many objections. Unfortunately it has passed into the category of fashionable maladies. So much has been written, and so many fanciful theories have been started regarding it, that it is difficult to present the subject in a rational manner to the student and practitioner. Such affections as "rose cold," "peach cold," "autumnal cold," and the like are open to the same criticisms. The truth seems to be as follows:—Certain individuals possess nasal mucous membranes susceptible to acute catarrhal inflammation from the contact of the pollen of grasses and plants, or even the emanations of animals. Such persons are usually young, of the neurotic temperament, and not infrequently asthmatic. Indeed, the connection between the two affections is very close, and vaso-motor changes in the nasal mucous membrane are held to be essential in the phenomena of "hay fever." A friend of the author's, for instance, would get an attack of acute rhinitis or asthma, or both, whenever he passed a flour mill.

The *treatment* of "hay fever" will not here be fully considered. There are few remedies in the pharmacopœia which have not been employed with more or less success against it. The affection is generally incurable, but admits of great relief by such constitutional remedies as the valerianates of zinc, quinine, arsenic, belladonna, and opium, and such local remedies as cocaine, alkalies,

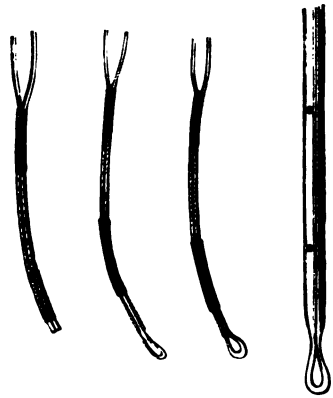


Fig. 661. — Galvano-cautery Terminals.

bismuth, weak solutions of carbolic acid, perchloride of mercury, or boric acid. It is of the first importance to detect and treat such conditions of the nose as mucous polypi, hypertrophy of the mucous membrane, or extensive septal deformity. The free application of the chemical or galvano-cautery, as before directed in hypertrophic rhinitis, has seemed to the author to give the best results in ameliorating the symptoms and preventing recurrence of the malady; but the prevention of the disease by change of locality should always be aimed at, if possible, and the tendency to nasal catarrh from slight causes frequently lessens as life advances.

Anosmia.—Loss of smell may be complete or incomplete, and is combined with loss of taste. Complete anosmia is caused by a variety of conditions. In the first class we may mention such causes as cerebral hæmorrhage, especially on the left side, basal meningitis, tumour or abscess at the base of the brain, or gross injury to the olfactory nerves in fracture of the anterior fossa. Some cases are found in chronic nervous disorders, as ataxia. It is obvious that the anosmia in these cases is but a part of more serious trouble, and it is a symptom rarely, if ever, remediable. Temporary anosmia is found in acute rhinitis after the inhalation of ammonia or other strong irritants. It is a familiar symptom in severe catarrhal swelling. Various degrees of loss of smell are found in obstructive diseases of the nose, especially nasal polypi and extreme deformity of the septum. In many of these cases inspiration is incomplete, and the inspired air is not carried to the neighbourhood of the superior and middle turbinals, where the olfactory filaments are largely distributed. In ozæna and atrophy of the mucous membrane, loss of smell is present, the evil odour being imperceptible to the patient. Disorders of the sense of smell, in the shape of disgusting odours, are common hallucinations of the insane.

The prognosis and treatment of anosmia must depend on the cause. The removal of tumours, polypi, and other obstructive conditions is often followed by improvement. But cases are met with in practice in which it is difficult, if not impossible, to assign a cause for loss of smell, and in which little treatment seems to be of benefit. Galvanism has been advised for some obstinate cases of anosmia, but generally I have been disappointed at the results.

Coryza (rhinitis).—The inflammatory conditions of the nasal mucous membrane terminating in hypertrophy or atrophy having been considered, it will here be well shortly to discuss some other varieties met with in practice. The term coryza is loosely applied to many forms of nasal discharge, but should be restricted to the acute forms of inflammation associated with profuse serous discharge, such as is exemplified in a "common cold in the head." It is a question whether many of these cases are not due to organisms. They are certainly infectious. In acute rhinitis the hyperæmia and swelling not uncommonly extend to the pharynx, middle ear, and frontal sinuses.

Causes and treatment.—This affection is produced by

such causes as cold, irritating vapours, pollen, dust, or certain drugs, as iodide of potassium. The treatment of this form of acute rhinitis belongs rather to the physician. Free diaphoresis, by means of Dover's powder and the hot bath, is always advisable; and locally soothing or slightly stimulant inhalations as benzoin, camphor, pine wood, and chloroform, are grateful. A 5 per cent. cocaine spray is of undoubted benefit. Acute rhinitis, associated with profuse purulent discharge, swelling and fever, is sometimes, but rarely, gonorrhœal. The patient will probably be suffering from the acute stages of the disease in the usual situation, and the glands over the parotid will be early enlarged and tender. Beyond protecting the eyes, the treatment presents nothing special. In like manner diphtheritic inflammation of the nose occurs, the characteristic fibrinous exudation being observed, with severe constitutional depression. The treatment is that of diphtheria in other parts. Any form of acute rhinitis may become purulent, and may remain so. A purulent discharge from the nostrils of children is common. Excluding such causes as foreign body and necrosis, already spoken of, such discharge will commonly depend upon ulceration of the mucous membrane, in dirty ill-nourished children, the subjects of constitutional syphilis or tuberculosis.

Long continued purulent rhinitis may, as pointed out, terminate in atrophic rhinitis (*ozæna*). Good diet and tonic treatment are essential in these cases, with constitutional treatment for syphilis or tuberculosis. Locally, antiseptic cleansing of the nose must be carried out, after which mild astringents are useful. Syphilitic coryza may also be found in severe secondary constitutional syphilis, and is usually associated with roseola or lichen on the skin, and the well-known "sore throat" of syphilis, while mucous "plaques" and patches may be seen on the palate and tonsils. The nasal mucous membrane does not often suffer from the mucous "plaques" seen on the throat or tonsils. This form of rhinitis readily yields to ordinary specific treatment. Very rarely the primary lesion of syphilis has its seat in the nose or naso-pharynx. Such cases are generally found after the use of infected instruments, especially the Eustachian catheter. They are associated with great swelling, high fever, and enormous glandular enlargement under the jaw and in the neck. A copious rash appears on the skin. The possibility of the occurrence of this great mischief should lead us to be very punctilious in the cleansing of all nasal instruments. In leaving this subject, it may be pointed out that a profuse watery or mucous discharge from one nostril may be caused by a mucous polypus, and when these growths occur in the antrum or frontal sinus, the true cause of the discharge is seldom discoverable. The purulent discharge and coryza of glanders will not be here considered. (*See p. 308, Vol. I.*)

New growths of the nasal cavities.—Many classifications are possible of the growths of the nose. Tumours may originate in the bones and periosteum, in the epithelium of the muciparous glands, or surface of the mucous membrane, or in the connective tissues.

Any form of soft new growth may become polypoid, or the subject of myxomatous change, with cystic formations, and interstitial hæmorrhages. Tumours of the malignant variety may invade the nose from other parts, particularly from the antrum or ethmoidal cells, and such cases should not be considered as growths of the nasal cavities. With these remarks the following classification may be presented to the reader :—

NEW GROWTHS OF THE NASAL CAVITIES.

Innocent	{	Mucous polypus (myxoma).
		Osteoma.
		Chondroma.
		Adenoma.
		Angelioma.
		Papilloma.
		Fibroma.
Malignant	{	Sarcoma, usually of the round or spindle-celled variety.
		Epithelioma, squamous or cylindrical.

Mucous or gelatinous polypus. *Causation and pathology.*

—This is a common morbid growth of the nasal cavities. Mucous polypi may occur at any age, but are most frequent between sixteen and forty years. The favourite site of origin is the outer

wall of the nose, near the middle turbinal, either upon the edge of that bone or beneath it (Figs. 662 and 663). These growths may also occur about the roof of the nose, and in the accessory sinuses, but rarely, if ever, do they grow from the septum. Causation is very obscure, but cold, damp, and irritating dust-laden atmosphere have been credited with originating nasal polypi. Every variation in size and contour may be noted, and the sessile proliferations of hypertrophic rhinitis are closely allied pathological conditions. The size of gelatinous polypi may vary from a No. 1 shot to a growth large enough to block the nose and cause external deformity. In like manner the pedicle may be attenuated, or



Fig. 662.—Pedunculated Mucous Polypus growing from the Middle Turbinal. (St. Bartholomew's Hospital Museum.)

broad and elongated, with a lobulated foliaceous growth dependent from it. Nasal polypi are almost always multiple, and the small ones are peculiarly liable to be overlooked. Mucous polypi occurring in the ethmoidal cells and the superior meatus absorb by pressure the papery bones in their vicinity, and have even been known to invade

the cranial cavity. In minute structure these growths may be constructed of pure myxomatous tissue, or loose connective tissue sodden with mucin. They frequently contain large cysts. The tumours are covered with ciliated epithelium, and when perfectly extirpated do not recur, though other like growths are apt to originate freshly. (*See* p. 460, Vol. I.) A sufficient number of cases have been related to show that in very exceptional instances mucous polypi, after repeated removal, may become sarcomatous and end in inveterate malignancy.

Symptoms and diagnosis.—The symptoms are those of nasal obstruction, worse in damp weather, sneezing, anosmia, and profuse discharge of mucus, while deafness or tinnitus is not uncommon, from associated Eustachian obstruction. The patient breathes through the mouth, snores at night, and is sometimes asthmatical. The voice is altered, having the peculiar "dead" twang found in nasal obstruction. Any respiratory affections, as chronic bronchitis or asthma, and some forms of cardiac disease also, are greatly aggravated by nasal polypi, and correspondingly benefited by their removal.

The gelatinous-looking growths are visible on illumination, and usually move freely to the probe. In bad cases the nostrils and nose are mechanically expanded. When these tumours originate near the posterior extremity of the middle turbinal, and project into the pharynx, they are peculiarly liable to be overlooked, unless a careful exploration be made with the rhinoscope and finger. The peculiar intonation of the voice is an important hint in such cases. The colour, consistence, slow increase, mobility, multiplicity and absence of hæmorrhage should differentiate these growths from sarcoma. Hypertrophied tissue at the end of a turbinate bone, an outgrowth of the septum, or more unfortunately a nasal meningocele, have been mistaken for this form of polypus.

Mucous polypi within the accessory sinuses are hard to diagnose. In the case of antral polypus, an important symptom is the running of watery fluid from the nostril in certain positions of the head.

Treatment.—(a) By injections or applications of caustics and astringents. Strong injections of chloride of zinc or nitrate of silver have caused sloughing and subsequent atrophy of these growths. I have used a bead of pure chromic acid on a probe with good result, thrusting the armed probe into the growth. I have also injected a few drops of a saturated solution of chloride



Fig. 663.—Sessile Mucous Polypus growing from the Middle Turbinal. (St. Bartholomew's Hospital Museum.)

of zinc, with the result that small growths sloughed and disintegrated. These methods are tedious for large growths, but are useful for the very small ones. The same remarks apply to electrolysis and the galvano-cautery.

(b) Operation by forceps or snare. As a preliminary, the parts must be well anæsthetised with a 10 per cent. cocaine spray. In nervous subjects general anæsthesia must be produced. Forceps should have serrated blades (Fig. 664), and be far more delicate and light in construction than those usually sold. Good illumination should be employed, and the operator should not grasp haphazard at any tissues that may come within the forceps. The operation of blindly pulling away the turbinals, or any other structures that come within reach, is rough, apt to be followed by necrosis, and is not devoid of risk. If performed without anesthetics it is horribly painful. The operation by the snare with fine steel wire is strongly to be recommended. The galvano-cautery snare has the advantage of checking all oozing, but the use of the cold steel wire is attended with little hæmorrhage. The shape and strength of the snare, the thickness of the wire, and the size of the loop must be modified according to the position and bulk of the polypus (Fig. 665). Many sittings are usually required, fresh growths coming into view as others are removed. The snare operation well executed under cocaine is practically painless. The case must be kept under observation for some months; any fresh growths, or remnants of old ones,

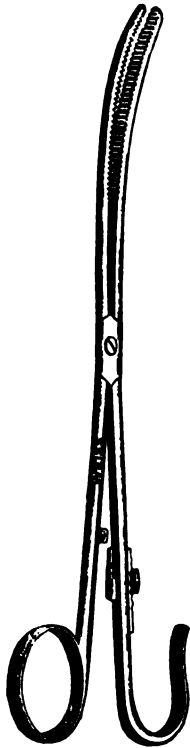


Fig. 664.—Polypus Forceps, with fine serrated Blades.

should be destroyed with chromic acid or the galvano-cautery, the surgeon aiming at obtaining cicatrisation about the sites of growth. Some cases of mucous nasal polypi are very troublesome, the nose being crowded with tumours. As fast as some are removed, fresh ones develop. In these obstinate cases, I have found the best results from opening the nasal cavities by Rouge's operation, and with a fine saw removing the inferior turbinals or the greater portion of them. This gives free access to the higher parts of the nose, and the growths can be now dealt with. Any polypi that can be safely reached may be removed

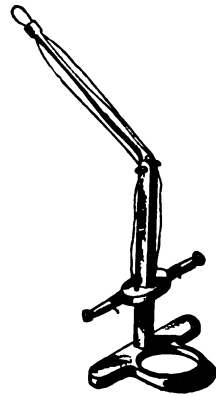


Fig. 665.—Nasal Polypus Snare.

with fine forceps. This operation is always dangerous, and only needful in exceptional cases. The hæmorrhage during its performance may be very embarrassing and profuse, and the assistance of a skilled anæsthetist is essential. The surgeon must always bear in mind that in the removal of polypi from the regions about the roof of the nose, cerebral complications may arise after operation. The utmost care should be taken, therefore, to keep the parts after operation as aseptic as possible. The author advises light plugging with wool tampons of boric acid after operation and the thorough flushing of the cavities twice a day with warm dilute antiseptic washes.

Osteoma.—True osteoma must not be confounded with bony spurs and outgrowths in the floor of the nose or the septum. The growth may be of the diffuse variety, huge lobulated masses of bone deforming the nose and jaws to a hideous extent. Some of these cases have been associated with "molluscum fibrosum" of the skin. Ivory exostoses have a preference for growing from the accessory cavities, as the frontal sinuses, the antrum, or the ethmoid cells. Some of these formations are really "odontomes" (p. 937, Vol. I.). Their increase is exceedingly slow, but is progressive and inveterate. Large exostoses cause local deformity, obstruction, and intolerable pain when nerves are stretched or pressed upon. They may become spontaneously detached (Fig. 666). From fibrous or cartilaginous tumours the diagnosis is made by the very slow growth, and by the exploring needle. I have known instances where spongy osteomata have grown symmetrically from the nasal bones, causing remarkable swellings on either side of the nose (p. 933, Vol. I.).

Chondroma.—Cartilaginous tumours rarely originate in the nose. The usual clinical characteristics of chondroma are observed, i.e. slow growth, a yellowish or blue tinge, a bossy lobulated outline, and elastic hardness. This growth can be penetrated by a hollow needle, which distinguishes it from bone, and a fragment may be thus brought away for microscopical examination. The treatment of osteoma and chondroma of the nose must be conducted on general



Fig. 666.—Large Odontome which separated spontaneously into the Antrum. The patient was a native of India. (St. George's Hospital Museum.)

surgical principles. It may be needful to open the nasal cavities by incision along the side of the nose, and removal of parts of bone from the superior maxilla.

Adenoma, angeloma, papilloma.—Adenoma of the nose is difficult clinically to distinguish from the mucous polypus. The treatment is the same, and the distinction of no material importance. Warty growths on the nasal mucous membrane may be removed by the snare or galvano-cautery. Nævoid growths have been described as occurring within the nose. All such formations are of a purple or florid colour, and bleed freely on manipulation with the probe. The galvano-cautery loop is the best method of removal, if any treatment be contemplated.

Fibroma, naso-pharyngeal polypus. *Pathology and symptoms.*—This important form of growth springs most frequently from the periosteum of the base of the skull, and commonly from the basilar process of the sphenoid, growing downwards and forwards into the nose. Should it arise from the roof of the nasal cavities proper, the following description will suffice. Authors are nearly unanimous in the description of these growths as pure fibroma. I venture to question this opinion. All the naso-pharyngeal polypi I have examined have had the microscopical characteristics of spindle-celled sarcomata, and clinically they have been marked by a tendency to recurrence. It is well known that the small spindle-celled sarcoma approaches very nearly to a fibroma, both microscopically and clinically. Myxomatous change is not uncommon in these tumours, and they are far more common in males than in females.

They grow steadily, sometimes with sudden increase, and may deform the face hideously by dilating the nose, and crowding forward the maxillæ. The palate is depressed, and the growth may seriously impede respiration. The attachments of the tumour may be broad and extensive, and hence the term "polypus" is not always a good one. The growth, moreover, may form new attachments by contact and pressure in the nares or accessory cavities. It is pinkish in colour, lobulated, very firm to the touch, and is commonly associated with repeated epistaxis, especially on slight manipulation. The bleeding may be profuse and dangerous from small erosions on dependent parts, which become deeply congested, the vessels being unable to retract in the dense fibrous tissue. In exceptional cases the orbit or cranial cavity may be invaded. These tumours generally occur in young males, and they prove fatal by sloughing and pressure, repeated bleeding, suffocation, or invasion of the cranial cavity. Cure by sloughing has occurred in a few cases, spontaneous extrusion is known, and disappearance by retrogressive growth has also been related.

Treatment.—The danger and misery caused by these formidable tumours are so great that their removal is always indicated. Hæmorrhage is the complication mainly to be feared. At the same time, the fear of hæmorrhage has been much exaggerated, and I have seen elaborate plans laid to meet bleeding which never occurred. Treatment by injections has been successful in a certain number of cases, a

saturated solution of sulphate or chloride of zinc being thrown into the tumour in different places with an appropriate syringe and needle. The length of time consumed, and the subsequent sloughing and hæmorrhage, are inevitable drawbacks to this treatment, and the same remark applies to electrolysis. At the same time, these methods are worth remembering when patients refuse operation, or when the attachments of the tumour preclude it. All kinds of operations have been devised for naso-pharyngeal polypus. Much will depend upon the presence or absence of a pedicle, and the ease with which the tumour moves about on manipulating it with the finger passed behind the palate. If any sort of pedicle can be made out, a stout steel wire should be manipulated round it, and this may be connected with the galvanic battery, and made to burn its way slowly through. If the écraseur snare be used with the cold wire, the screw must be turned very slowly. An hour is not too much time to consume in the severance of the pedicle. In extensive growths, free access may be obtained to the base of the tumour by removal of the lower part of the superior maxilla. This is the operation I have always performed myself, and I strongly advise it. An incision may be made through the lip and around the nose. The whole nose being turned upwards, the palate is sawn through, and the maxillæ are levered apart. Very free access is thus obtained to the roof of the nasal cavities. Surgeons have also divided the soft palate to obtain room for manipulation. There is the widest difference in the vascularity of these tumours. Hence some surgeons advise avulsion by forceps, and safely perform it. Should the growth, however, have very extensive attachments, and happen to be exceedingly vascular, the danger from loss of blood, if it is torn off by forceps, will be great. The aid of a highly skilled anesthetist is essential, and if the growth completely fills the pharynx, it may be needful to perform a preliminary tracheotomy, and cover the aperture of the larynx with a suitable sponge. If the tumour be dangerously vascular, and its base unilateral in position, a temporary ligature may well be placed upon the carotid artery as a preliminary measure. Finally, no one should attempt to treat these cases, unless he has had good experience in the greater operations of surgery.

Malignant intra-nasal growths, sarcoma, and carcinoma.—It is not often possible, even with the microscope, to diagnose the exact variety of malignant growth that may present within the nose. Many forms of rapidly-growing soft tumours, which formerly were termed "medullary" or "encephaloid" cancers, are now known to be soft sarcomata. A growth attended with much ulceration occurring on the septum or near the muco-cutaneous junction will probably be a squamous epithelioma. Soft sarcomata frequently assume the polypoid form, and are very prone to invade the nose from one or other of the accessory sinuses, their origin being thus far deeper than is expected (Fig. 667). The clinical evidences of malignancy in an intra-nasal tumour may be thus summarised. The patient is probably very young, or over fifty years of age. Growth is rapid and progressive.

Infiltration of the soft parts is observed with a dusky congestion of the skin and enlargement of the veins. The orbit may be invaded, and the eyeball displaced. Epiphora is often observed. Arterial epistaxis is common. Any portion of growth that can be seen is livid, with a tendency to fungate, and bleeds on the least touch from the probe. Glandular enlargement and cachexia are dubious symptoms, but the patient loses flesh and weight, and tumours may arise in other parts of the body. The close similarity of nasal necrosis to some of these tumours is remarkable.

In the *treatment* of these cases, unless a free removal of the

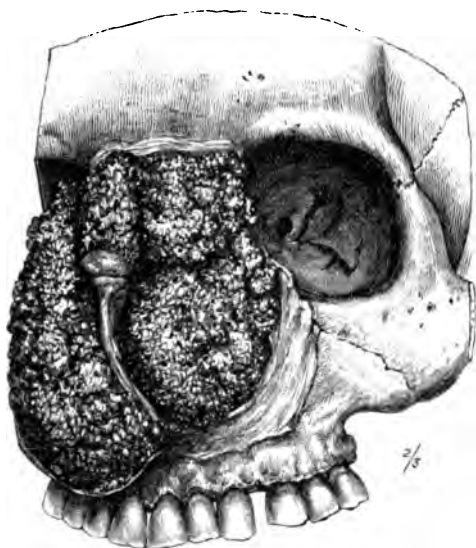


Fig. 667.—Sarcoma of the Nose, invading the Antrum and Orbit. (St. George's Hospital Museum.)

growth and also its site of origin can be effected, the surgeon will do well to stay his hand. Extensive portions of the upper jaw have often to be removed, and the operator will then be surprised and dismayed to find how seriously the disease has extended posteriorly. Should the accessory sinuses be obviously filled with growth, the eyeball protruded, or the soft parts of the face implicated, the most extensive operation will probably fail in thoroughly eradicating the disease, which will recur with fresh virulence

and most disappointing rapidity. (See Fig. 667.)

Treatment of malignant growths of the nose and pharynx by the toxin of erysipelas.—This method has been tried in America on cases of hopeless sarcoma in various parts of the body, with a temporary success, which merits mention in this work. Some of the ultimate results related are very striking. The method is dangerous, for cultures of virulent erysipelatos virus have to be injected over several months. The patients become extremely ill, and the tumours slough. During the treatment careful nursing and stimulation must be carried out. The doses administered by our American confrères appear to have varied from 15 to 40 minims of a filtered solution of the toxins of erysipelas and bacillus prodigiosus. A temperature of 58° C. is said to kill the germs, but does not destroy the chemical products. So hopeless and desperate are some cases of

sarcoma of the nasal cavities that I feel sure that this method warrants a trial in the surgical practice of Great Britain.

Rhinoscleroma.—This term was applied by Hebra to a rare form of growth which commences in the mucous membrane or skin of the upper lip, near the margin of the nostril, and advances slowly towards the naso-pharynx or oral cavities. Microscopically, the disease consists of a dense small-celled infiltration of the deeper layers of the skin or mucous membrane, leading to atrophic changes in the normal structures. A tendency towards development into fibrous tissue has been observed, and a small rod-shaped bacillus has been described in the round cells and lymphatics. The true connection of this with the disease is at least doubtful. (See p. 38, Vol. I.)

Clinically, the malady is characterised by the development, in healthy adults, of flat nodules or plates of cartilaginous hardness in the tissues, which gradually extend and coalesce. The skin is a little dusky, or smooth, white and shiny, but there is no tendency to ulceration, beyond cracks and fissures at the nostril margins. The affection is painless, and the growths are but slightly tender on manipulation. After years of slow progression the nasal passages, oral cavity, or even the larynx may become seriously narrowed, obstructed, and deformed, otherwise the health remains unaffected. This affection has to be diagnosed from sarcoma, and from gummatous infiltration of the skin. In doubtful cases anti-syphilitic remedies should always be tried.

In advanced cases treatment is very unsatisfactory. Should the disease be diagnosed early, free excision of the nodules should certainly be practised.

Adenoid vegetations of the naso-pharynx. Causation and pathology.—Much attention has of late years been given to this affection, first described by Czermak and Meyer of Copenhagen. The vault of the pharynx is covered with a mucous membrane rich in lymphoid tissue, and this is collected into two lateral masses (pharyngeal tonsil) near the orifices of the Eustachian tubes, behind the pterygoid processes of the sphenoid bone. In delicate children and young persons of the lymphatic temperament, this tissue, in common with the tonsils, pharyngeal glands, and lymphatics, undergoes great hypertrophy from such slight exciting causes as damp, a dusty atmosphere, and unhealthy hygienic surroundings. Both sexes suffer about equally. The minute structure of "adenoids," therefore, is that of pure lymphoid tissue mixed with connective tissue, and they are essentially hypertrophic growths and not true tumour formations. In bad cases the masses of soft, tongue-shaped vegetations depress the soft palate, block the nose, obstruct the Eustachian orifices, and cause deafness, serious respiratory embarrassment, and deterioration of the general health. Large masses of unhealthy inspissated mucus are mingled with the growths. The teeth are apt to become carious from constant exposure in mouth-breathing, and the arch of the palate may be unduly high. As time advances these formations usually shrivel spontaneously, and they are comparatively rare after

twenty-five years of age. Cases are not unknown, however, at a later period.

Symptoms.—The appearance of the patient is diagnostic. He has a vacuous appearance, with a half-opened mouth (Fig. 668).



Fig. 668.—Facial Expression in a Patient suffering from Adenoid Growths.

He is more or less deaf, and probably from that reason is generally provokingly stupid, being unable to hear conversation or learn lessons like other boys. The speech is altered, the child "biting his words," as saying "lub" for "rub." He snores loudly at night and in very young children attacks of choking and night terrors are not uncommon. Should mouth breathing be checked, the patient is usually able to "blow his nose," and this must not be taken as a test of the presence or absence of obstruction.

Fluids injected up one nostril do not return by the other, as is the case when the naso-pharynx is clear. The tonsils are enlarged and friable, the pharynx is "granular," the soft palate is depressed, and fragments of growth may often be seen projecting behind it. The nose is commonly narrow and constricted. If the protected finger be rapidly passed behind the palate, the soft friable growths will readily be felt, and the finger will be removed smeared with blood. A certain excess of lymphoid tissue is to be found in the naso-pharynx of most delicate children, and is scarcely to be defined as pathological or necessitating operation. The deafness varies in severity, is worse in damp weather, and not uncommonly perforative otorrhœa is found as well. Adenoid growths, like enlarged tonsils, vary much in size, according to the amount of congestion present.

Treatment.—When adenoid growths are abundant and causing trouble, they should be removed. It does not follow that every child who has a little lymphoid tissue in his naso-pharynx should be operated upon. The indiscriminate adoption of a really beneficial operation threatens to bring it into disrepute. Treatment by astringents, caustics, or cautery is slow and unsatisfactory. Before operating



Fig. 669.—Löwenberg's Forceps.

the surgeon should assure himself that the patient will not afterwards be exposed to the emanations of sewer gas or the virus of scarlet fever or diphtheria. Inquiries as to the possibility of the hæmorrhagic diathesis should never be neglected, and in this constitutional condition the operation had better not be

performed. Generally anæsthesia is needful and considerable skill and care are requisite in the administration. In young and courageous adults the operation may be done after well spraying the parts with a 10 per cent. solution of cocaine. A strong gag being fixed in the mouth, the growths are picked away with Löwenberg's forceps (Fig. 669), or cut away with a ring knife of appropriate shape and curvature (Fig. 670), or scraped from their attachments with a steel nail (Fig. 671), or the unguarded nail of the operator. In children these growths are so soft that the nail of the forefinger vigorously used will readily detach them under nitrous oxide gas anæsthesia. In young adults the growths contain comparatively more connective tissue, and the ring knife is then very useful. The objection to the forceps is the possibility of injuring the Eustachian tubes, and this I have seen happen in the hands of experienced operators. The forceps is, however, needful in the tough, almost fibrous, masses found in the nasopharynx of young adults. The steel nail (Dalby), used vigorously and methodically with strong sweeps, will scrape away the growths in the vast majority of cases, and the nail of the operator may complete the proceeding. The sudden gush of blood which occurs in this operation is alarming to the inexperienced operator, and dangerous to the patient if he be deeply anæsthetised and his position faulty. The blood thickened with inspissated mucus and fragments of soft growth



Fig. 670.—Gottstein's Ring Knife.

will soon fill a small basin, and if such a compound be sucked into the air-passages by inspiration, the patient will probably die asphyxiated. More fatalities have occurred from this cause than is generally acknowledged. Many positions are advocated, and I have tried most of them. I prefer the patient to be placed on the side with the neck extended, the head hanging a little over the side of the table. The blood then flows into the dependent cheek, from whence it can be readily sponged away, the air-passages



Fig. 671.—Steel Nail for Adenoid Growth.

remaining quite free. In case of the gag slipping, the operator will do well to protect the root of his index finger with a guttapercha ring or fold of lint. Most operators advise that no after-treatment, beyond protection from cold, be instituted in these cases. Sometimes after operations for adenoids suppurative otitis media occurs, and I usually insufflate the naso-pharynx with powdered boric acid just after the operation, and have the nasal passages gently syringed through with warm alkaline and antiseptic lotions for a week.

The result of this operation is usually most gratifying in the improvement, not only of the deafness, but of the intelligence, digestive powers, general health, and respiratory system of the patient. The operation should be done very thoroughly. Re-

currence takes place in a limited number of cases, but it is quite exceptional. In conclusion, it may be pointed out that nasal obstruction from mucus and swelling may occur in very young infants, who may then be unable to "suck," and frequently suffer from "laryngismus stridulus." The mere dilatation of the posterior nasal passages with the finger will prove highly beneficial.

Tumours and affections of the external parts of the nose.—*Gangrene* of the tip of the nose is found as a sequel of bad cases of fever, after typhus or typhoid, and also in "frost-bite" and in Raynaud's disease.

Eczema, *erythema*, *erysipelas*, *sypphilis*, and *acne rosacea* are all found on the exterior of the



Fig. 672.—Rodent Ulcer of the Nose which had existed many years in a Man of seventy years of age.

nose. They present nothing peculiar. *Lupus vulgaris* has its favourite site near the junction of the cheek and ala of the nose. (See p. 715, Vol. I.) It is characterised by commencement in early life, asymmetry, the well-known dusky infiltrated skin, with ulceration and formation scabs, of crusts, or exuberant fungoid granulations. On close inspection, especially aided by a lens, the brown translucent tubercles ("apple jelly" deposits) are plainly to be seen about the margins of the patch. Extensive destruction is produced by lupus, and the subsequent cicatrisation leads to considerable deformity and occlusion of the nostrils. The lupoid deposit finally invades the mucous membrane of the nares, and may even spread to the palate and fauces. Some of the worst of these cases are found in the highly tuberculous, or the subjects of congenital syphilis, and it was to the ravages of fungating lupus in such cases that the old term "noli me tangere" was so applicable.

Lupus erythematosus occurs on the nose, where the central part of the well-known "butterfly patch" crosses the bridge. It occurs usually in females about the age of forty, is symmetrical, devoid of ulceration, and the skin dusky-red or congested, is covered with minute white scales or crusts, which are removed with difficulty and some little bleeding. Frequently, similar patches are found on the ears or scalp.

Epithelioma and *rodent ulcer* (Fig. 672) are both found on the nose, the former near the muco-cutaneous junction. (See also Fig. 22, p. 125, Vol. I.) *Syphilitic ulceration* may be met with in the later stages of the disease, and is apt to be mistaken for one of the foregoing affections. The serpiginous outline and dusky margin of the ulcer, the absence of induration, the rapid progress, and the scars of like ulceration in other parts, will guide the surgeon. Such ulceration may occur many years after the original infection, or in elderly married women who have no suspicion of constitutional disease. Hence, history in these cases is seldom available.

The treatment of all such affections presents nothing special. It is of the utmost importance to attack lupus or other destructive ulcerative maladies early and energetically, before there is extensive implication of the soft parts. Should a patch of lupus vulgaris be detected early, I believe free excision of it, going well into the healthy skin, to be the best treatment. In many cases where the soft parts of the nose have been extensively removed, much can be done by plastic operations to restore appearance and symmetry.

An important growth of the soft parts of the exterior of the nose is the tumour to which the name "*lipoma nasi*" is applied. From a perusal of the published cases of this affection, the minute structure seems to differ, but the growth is evidently largely hypertrophic, and all the structures of the skin share in the hypertrophic process. The growth will thus be composed of fat, connective tissue, and adenomatous growth of the sweat and sebaceous glands. In some cases the glandular structure is so prominent that the name "*adenoma sebaceum*" has been applied. It will be remembered that this term is also used by dermatologists to denote tiny round whitish tumours scattered over the skin generally of the face, in a certain affection of the sebaceous glands. "*Lipoma nasi*" is found in elderly persons, usually males, who are frequently corpulent, often alcoholic, and generally exposed to the vicissitudes of the weather. The unsightly lobulated growths of a fierce red colour, or blue and congested like the wattles of a turkey cock, make the diagnosis obvious. They are a source of great disfigurement, and if the patient has not diabetes, advanced renal degeneration, or is not otherwise bodily disqualified for a "decorative" operation, the growths may be removed by appropriate incisions, as much skin as possible being saved. The result is generally very satisfactory.

Affections of the accessory sinuses.—It has been pointed out that new growths, as osteoma, mucous polypi, or sarcoma, may

originate in the accessory sinuses, and secondarily invade the nose. Acute nasal catarrh commonly spreads to the lining membrane of the sinuses. Obstructions of the outlets of the sinuses, by swelling, cicatrisation after operations, or by the growth of polypi, may give rise to distension of the cavities by retained mucus (mucocoele). Cysts of considerable size may also originate in the mucous membrane of the walls of the accessory sinuses. Retention of discharge may cause chronic abscess, and the distension of the ethmoidal cells, the antrum, or the frontal sinuses by mucocoele or chronic abscess, can only be certainly diagnosed from new growths by exploration. Acute or sub-acute abscess of the sinuses is found in bad syphilis or tuberculosis, associated with necrosis; as a sequel of the specific fevers and, more rarely, of facial erysipelas; from blows, or after intranasal operations, and from the entrance of insects or maggots. It has been asserted that abscess of the sphenoidal cells has followed basal meningitis, but this seems to be a confusion of cause and effect.

The symptoms of these affections are often most vague, and their differential diagnosis is extremely difficult. Abscess of the antrum being so common, exploration of this cavity by tapping in the usual situation, or in the outer wall of the nose, should never be neglected (p. 925, Vol. I.). Transillumination with the electric lamp should always be employed as a diagnostic aid. The leading symptoms of abscess in the various sinuses, excluding the antrum, may thus be summarised:—

1. **Abscess of ethmoidal cells.**—Discharge of yellow non-fœtid pus from high up in the nose, which usually escapes anteriorly, but may also flow down the pharynx. Severe, deeply-seated pain about bridge of nose and back of orbit. Redness, swelling, and bulging of inner wall of orbit, exophthalmos, external squint with diplopia, and narrowing of the field of vision. On pressure of the swelling at the inner wall of the orbit, pus may exude from high up in the nose.

2. **Abscess of frontal sinus.**—Practically not found before the age of sixteen. Flow of yellow pus from the neighbourhood of the middle turbinate bone. Severe frontal headache. Swelling at upper and inner part of orbit or over forehead. The abscesses may burst here, or erode the posterior wall of the sinus, leading to meningitis or cerebral abscess. The symptoms are then exceedingly severe, and comprise agonising pain, high fever, rigors, with delirium, and coma. These affections are puzzling, and in one case seen by the author the diagnosis of typhoid fever was arrived at during life. The flow of pus from the nostril may be quite absent from obstruction to the duct.

3. **Abscess of sphenoidal cells.**—Flow of yellow pus principally down the pharynx. Severe deeply-seated pain radiating about the face in the course of distribution of the filaments of the trifacial nerve. Optic neuritis and rapid contraction of field of vision, terminating in blindness and atrophy of optic nerve. Implication of third nerve, causing ptosis, dilatation of the pupil, or external strabismus.

General remarks.—Retention of pus in acute abscess of any of

these cavities may lead to severe symptoms of sepsis, and even to meningitis or pyæmia, otherwise unexplainable. Acute ethmoidal or frontal sinus abscess may be mistaken for lachrymal abscess or erysipelas. Localised bulging and yielding of the bones is the most certain sign of the localisation of these abscesses, and the one upon which a careful surgeon will principally rely. When this symptom occurs, exploration with a fine trochar will do the rest. I have known chronic abscess of the ethmoidal cells closely simulate sarcoma.

Treatment.—(1) Remove all obstructions to drainage, as polypi and enlarged turbinals. Thoroughly cleanse the nose with the antiseptic douche. (2) Effect drainage of the cavities. It has been pointed out that the *ethmoidal cells* can be well evacuated by using a small curved curette through the middle turbinated bone, into which the cells extend. Few are aware of the real height of the middle turbinal in the nares, and how difficult and risky such an operation may be, especially in a contracted nose. Should there be bulging at the inner wall of the orbit, it is far better to operate in this position, and, to obtain more room, the nasal bone may be displaced by cutting along its articulations with a firm forceps, and levering it downwards. An opening is then made into the nose by passing the finger upwards towards the site of operation, and meeting it by a curved curette from above. Very free drainage can be established, while the opening enables the operator to pick or curette away the diseased bone, and to flush the parts with hot lotions.

To open the *frontal sinus* a free incision should be made from the inner to the outer part of the superior margin of the orbit, and another downwards from it to the inner canthus. The soft parts being raised together with the periosteum, a free opening should be made at the "yielding spot" with a fine gouge, and the finger should be introduced to feel for carious bone. Should there be any suspicion of implication of the opposite sinus, this should be broken into through the same opening. The lining membrane should be well scraped with the curette. Finally, a passage should be made into the nose by passing the finger up the nostril, and meeting it by a curved perforator thrust from above. A large tube should be most carefully secured *in situ*, and through it the cavities should be flushed with dilute iodine and water, or if there be purulent discharge, with a 10 vol. solution of hydrogen peroxide. The soft parts in the orbit can now be united accurately. Drainage must be long continued.

To open the *sphenoidal sinuses* Max Schaëffer advises that a curved sharp trochar should be passed along the upper border of the middle turbinal, the operator being guided by the rhinoscope. The handle should be depressed, and the point made to enter the cavities. These spaces may also be tapped by a curved trochar behind the pharynx. The electro-motor drill has been advised. Many of these and like operations are very hazardous. The writer recommends that the nose be freely opened superiorly, and a stout curved perforator passed backwards to meet the guiding finger in

the pharynx. The "yielding spot" being detected, the perforator is made to enter the distended cells by cautious boring and pressure. The sudden evacuation of pus or mucus from these cavities has caused severe syncope and serious signs of cerebral disturbance, and all such operations on the sinuses at the roof of the nose must be conducted with peculiar caution and judgment.

Congenital deformities of the nose.—Congenital deformities of the nose are uncommon, and are usually characterised by absence of parts, due to failure of coalescence of the boundaries of the olfactory pit, the median and lateral nasal processes. Thus, huge and unsightly chasms may be left extending into the mouth or orbit, or the nasal depression may be entirely absent, two holes representing the nostrils. These deformities are usually associated with gross malformation and various degrees of monstrosity, and the subjects fortunately seldom survive. It has been mentioned that the septum is frequently deformed congenitally, and rarely the turbinals are split and curled as to obstruct the nasal passage, or one of these bones may be distended into a large air-containing cavity. Stenosis from thickening of the bones is also found, and bridges or spicules of osseous tissue have been seen spreading across the orifices of the posterior nares. Fibrous webs or septa of toughness and density have been observed congenitally. They may occlude the anterior or the posterior nares. Doubtless some of these formations are really cicatricial, and due to traumatism or extensive ulcerations about the posterior nares, such as are found in bad cases of scarlet fever. Congenital deficiency of the roof of the nares near the frontoethmoidal suture may give rise to a nasal meningocele.

Treatment.—Appropriate proceedings in plastic surgery may be adopted in absence of the nose, or in chasms and fissures. No rule can be laid down for these. All depends upon the ingenuity and deftness of the operator. Bony occlusions may be perforated with a rose-headed drill. Congenital webs may be incised, or destroyed with the galvano-cautery. At the posterior nares a pair of forceps may be thrust through the obstruction, and by opening the blades the web may be torn across. Great care should be exercised in the after-treatment that the membrane does not re-unite.

Affections of the septum nasi. Deformities of the septum nasi.—These may be congenital or acquired. The septum is rarely quite straight, and considerable malformation may occur from accidents or congenital causes. The cartilaginous portion is chiefly affected. Injuries, especially blows on the nose in early childhood, may lead to bending with angular deformity of the septum, and even to lateral displacement of it from the floor of the nares (Fig. 673). Vertical fractures marked by a distinct ridge are very common. Lateral deformities, with a concavity on one side, and a convexity, angular or obtuse, on the other, are frequent. The projection, if extreme, may even impinge upon the inferior turbinal and cause pressure ulceration. A rigorous classification of all the

possible deformities of the septum would be extensive and serve little useful purpose. Septal deformities must not be confounded with cartilaginous or bony ridges, spurs, and outgrowths from the septum or floor of the nares. In these cases there is not of necessity a corresponding concavity in the opposite nasal passage. Deformities and outgrowths of the septum produce some nasal obstruction, and they may aggravate such conditions as hypertrophic rhinitis, asthma, or bronchitis. Chronic middle ear inflammation is found on the same side in a significant number of cases, as though the associated

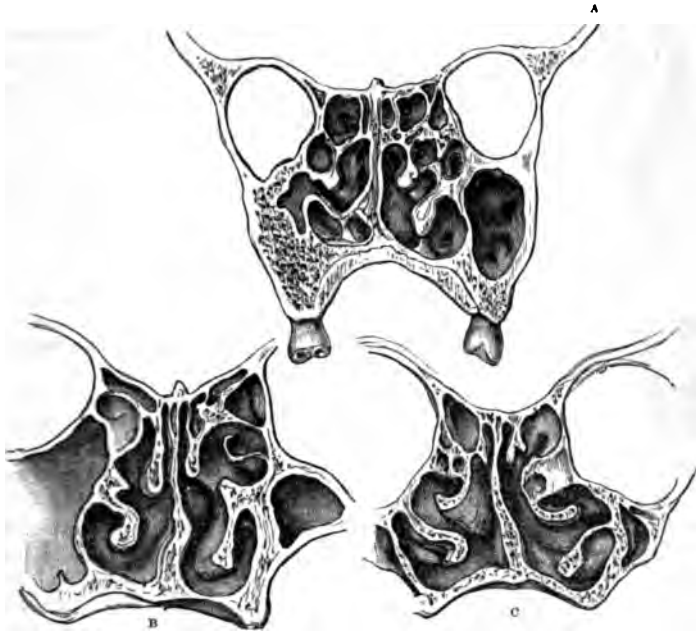


Fig. 673.—A, Dislocation of the Septum from the Floor of the Nares ; B, Angular Deformity ; C, Obtuse Bending of the Septum.

Catarrhal processes had spread up the Eustachian tube. Having taken some trouble to investigate this matter, I have been surprised at the number of individuals with considerable deformity of the septum, who suffer no appreciable discomfort from this condition ; and whose hearing remains perfectly good.

Treatment.—Much controversy exists regarding the evils, local and remote, that have been attributed to a deformed nasal septum, but it is scarcely necessary to give an account of the various opinions brought forward. The amount of obstruction and local inconvenience caused to the patient must be our guide to interference. Minor cases had best be left alone, and extreme instances only submitted to operation. Some of the principal methods advocated for the restoration of a deformed septum are as follows:—

(1) Fracturing, or forcibly bending back into position, with flat-bladed forceps (Fig. 674), afterwards long retaining the parts in position with intra-nasal splints, until healing in the rectified position has taken place. The cartilage is exceedingly elastic, and ultimately springs back into its old position most persistently, unless well fractured. This procedure, associated with the name of Adams,



Fig. 674. — Septal Forceps.

will frequently improve these cases, but it is most difficult perfectly to straighten a crooked septum by means of it. Fracture, rather than bending, should be aimed at, and to fracture the cartilage by lateral bending is far from easy. The operation and after-treatment are tedious and painful, and unless nasal splints and other apparatus are worn for a long time, relapse, especially in adults, is common.

(2) A modification of the above is the operation by the punch septal forceps, the ring blade being placed on the concavity, the punch on the convexity, of the septum.

(3) It has been recommended to incise the cartilage by knife or scissors before bending it into position; and excision of the projection has been practised, after dissecting up a flap of mucous membrane, to be afterwards replaced.

(4) In extreme cases, which, in my opinion, alone require treatment, nothing has seemed so good as the removal of the projection with an extremely fine saw, made to work behind a long needle, transfixing the projection. The more the projection takes the form of an angular outgrowth, the more is this operation needed, and it has the strong support of Bosworth. A flap of mucous membrane is raised after incision with a fine curved rougine, and after removal of the angular projection the flap falls over the site of operation, and is retained there by a pledget of oiled lint. A small opening is sometimes made into the opposite nares, but less often than one would think, and after healing, this is insignificant. The bleeding is temporarily free, but seldom gives serious trouble, and plugging is easily performed. The simplest form of dressing is all that is requisite after removal of a portion of the septum. I have used pieces of soft drainage-tube, wrapped round with lint, covered with white precipitate ointment. The patient should be protected from cold and sewer gas emanations, and the nose daily syringed with warm antiseptic lotions.

(5) Some operators burn away cartilaginous outgrowths with the galvano-cautery; this proceeding seems to have little to recommend it. The removal of bony outgrowths from the floor of the nares, by drills or burrs, is only called for if they give rise to serious impediment of nasal respiration.

Hæmatoma; abscess; gumma; new growths.—*Blood tumours* may be found on the septum after injury, forming fluctuating

swellings of a considerable size. I have seen one case of this nature which arose spontaneously in an aged person from the giving way of a septal vessel. No treatment is, as a rule, required. Should much local obstruction be complained of, aspiration with a fine hypodermic syringe may be repeatedly employed. Early incision should be practised in suppuration.

Acute *abscess* of the septum is sometimes met with, associated with severe pain, swelling, and nasal obstruction. Should perforation of the septum occur, the swelling bulges into both nostrils. This affection may follow injury, or be associated with necrosis of the cartilage, and must not be confounded with a rapidly disintegrating gummatous formation. In the treatment of this affection a free opening is essential, any sloughy tissue should be removed with a curette, and the cavity be dressed from the bottom with iodoform and boric acid.

Gummata may arise from the periosteum over any of the nasal bones, and they are peculiarly liable to form on the septum, where they are associated with necrosis of the cartilage and perforation.

The *new growths* of the septum are sarcomatous tumours and *epitheliomatous* formations of the muciparous glands. Such affections are uncommon, and their diagnosis is made on general principles. Progressive, rapid increase, and a tendency to infiltrate deeper parts, and to recur *in loco* after removal, are the leading characteristics. In investigating ulcers and new growths of the nose, the possibility of gumma should ever be present to the mind. The tendency to soften in the centre, and break down into pus and debris, is very characteristic. Specific treatment cannot be too soon adopted.

In the later stages of nodular *leprosy*, gumma-like masses form in the septum, extensive necrosis follows, and the nose sinks in, much adding to the distress and hideous deformity that the patients present. The other symptoms of the disease, especially leontiasis, are evident.

Perforating ulcer of the septum.—Most perforations of the septum are due to syphilitic ulceration. A few are due to traumatism, or to the results of abscess of the septum. In exceptional cases the septum is congenitally deficient. There is, however, a peculiar form of ulcer of the septum starting in early or adult life, which slowly, almost imperceptibly, extends until it attains the size of about a shilling, when the edges feebly cicatrise, and it remains stationary for years or for life (Fig. 675). The general health is unaffected, there is no pain, and no history or signs of syphilis or tuberculosis. It does not extend like rodent ulcer. It seems likely that this affection is really due to an exceedingly chronic form of lupus. I have a case under observation where a septal perforating ulcer of this nature has remained about the size of a sixpence for over thirty years. Some authors affirm that the ulceration commences by erosion on the summit of a septal projection, and is extended by "picking" on the part of the patient. It has

been noticed as common in those employed in cement manufacture, and in workers with arsenical preparations and bichromate of potash. No active treatment is required.

Hypertrophy of the mucous membrane of the septum.

—The mucous membrane over the septum nasi may be thickened and spongy, in association with general hypertrophic rhinitis. Any localised mass of tissue may well be treated with the galvano-cautery, chromic acid, or other appropriate chemical agents.

Removal of the turbinated bones.—Great differences of opinion exist regarding the indications for this operation. Without pretending to be dogmatic, I would here state that I believe the

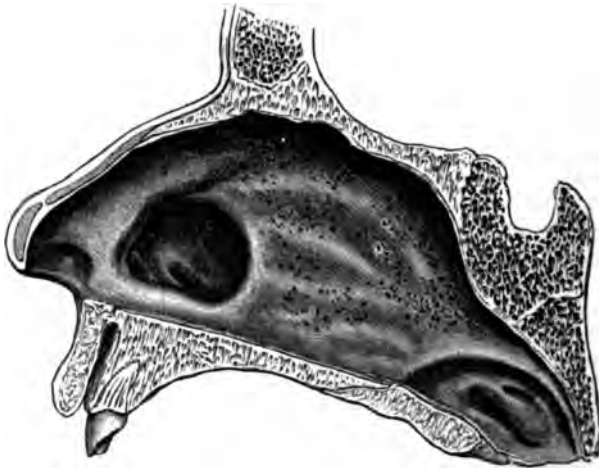


Fig. 675.—Chronic Perforating Ulcer of the Septum Nasi.

necessity for this proceeding to be comparatively rare. It has often been performed for unhealthy conditions of the mucous membrane, such as hypertrophic rhinitis, whereas I have pointed out that in such cases the membrane itself should receive treatment and attention. The bone usually removed is the lower turbinal. The middle turbinal lies higher in the nose than is generally supposed, and its removal is difficult and attended with corresponding risks. The lower or middle turbinated bone may be removed for the following conditions: (1) in obstinate cases of multiple and recurrent nasal polypi, when the mucous membrane is covered with small growths, and drainage of mucous or purulent discharge is interfered with; (2) in rare cases of cysts, or irregular bony hypertrophy, when nasal respiration is much impeded—such instances are found after bad fractures of the nose; (3) in some cases of necrosis of the nose, to remove actual disease, or to facilitate drainage from the ethmoidal regions.

In all cases anæsthesia should be employed. The bones may be

removed in various ways, as by a strong ring-knife, fine curved scissors, the *écraseur*, or by the old-fashioned plan of twisting them out with forceps. An easy and expeditious method which I have employed on the few occasions I have performed this operation, is to separate the bone from the outer wall of the nose by a fine, long saw, working from above, and to complete the removal by fine polypus forceps. In cases where the posterior extremities of the turbinals need removal, an *écraseur* snare, or ring knife, may be employed.

The bleeding may be free. If it should prove obstinate, syringing with a hot alcoholic solution of tannin will be very efficacious. Finally, the nose is plugged lightly with strips of lint impregnated with boric acid, and the patient keeps the recumbent position. The plugs are removed in twelve hours. In the after-treatment the nose is douched daily with a dilute antiseptic, and powdered boric acid used as a snuff, while a gauze mask is worn upon which such antiseptic applications as eucalyptus oil, dilute carbolic acid, or "Sanitas" may be applied. The results of this operation, in cases where it is really needful, are very beneficial.

Concluding remarks upon intra-nasal operations.—No intra-nasal operation is free from risk, and even the removal of a simple polypus has been followed by septic meningitis. Operations high in the nasal cavities are always dangerous. The large venous sinuses towards the roof of the nose are in direct communication with the longitudinal sinus, and purulent phlebitis or meningitis with general pyæmia may readily be induced. After a nasal operation the patient should be kept in an equable temperature. He should avoid insanitary conditions, and especially the exposure to the infections of erysipelas, scarlet fever, or diphtheria. The site of operation should be cleansed with antiseptic sprays or douches, and the inspired air should pass through a mask well saturated with an antiseptic preparation, as eucalyptus or thymol. It is hardly possible to render the nose thoroughly aseptic, but the washing away of blood-clots and débris of discharge must lessen the risk of septic infections. Intra-nasal operations are generally considered as falling into the minor class, hence disasters should never occur in them. I would strongly urge upon the profession that great care and precaution should be exercised in advising an intra-nasal operation, in its performance, and especially in its after-treatment.

Dangerous hæmorrhage, in exceptional cases, may follow even slight intra-nasal operations. Thus, the cutting away of a septal projection, or a turbinal bone, may be followed by such persistent bleeding as to necessitate plugging of the nares. I need hardly point out the risk of hæmorrhage from intra-nasal operations, in those who suffer from renal or cardiac disease, or who possess atheromatous vessels. Patients submitted to nasal operations should, therefore, be kept under careful supervision, until sound healing is evident.

XLIII. INJURIES AND DISEASES OF THE NECK.

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Contusions of the neck.—Contusions of the neck may cause death from shock or spasm of the glottis. The hyoid bone may be fractured, and occasion pain and swelling, with difficulty in deglutition and articulation. Turning the head or any movement of the tongue is accompanied by pain. Crepitus or some irregularity will be elicited by external examination; and occasionally, by looking into the mouth, some ecchymosis and swelling of the mucous membrane may be seen. Fracture of the hyoid bone is a rare accident, and is caused by a direct blow or by the grasp of a hand as in garotting.

Treatment.—The head and neck should be supported by a back splint, cold applied externally by means of ice-bag or lead coil, all attempts to speak be avoided, and if swallowing is difficult, food must be administered by the nasal tube.

Bruising or fracture of the larynx is caused in the same manner as fracture of the hyoid bone, but may also be occasioned by a fall against some projection. Fracture is most likely to occur after ossification has taken place. Externally there may be swelling from extravasation of blood, with perhaps local emphysema. A rapid swelling will generally take place within the larynx, and may be recognised by the laryngoscope. The voice will be altered in character, and probably reduced to a whisper.

The *treatment* consists in perfect rest, the application of a lead coil to the neck, and if obstruction to breathing is increasing, tracheotomy will be necessary. When, however, the difficulty in breathing is occasioned by swelling following a bruise, and there is no evidence of any fracture or displacement, intubation may be with advantage substituted for tracheotomy.

Fracture of the cricoid cartilage and subcutaneous rupture of the trachea are very dangerous accidents, and can only be caused by great violence. They are attended by severe shock, great difficulty in respiration, and extensive emphysema of the neck, which

may spread in a few minutes over the whole body. The fracture may be determined by examination of the cricoid, or a distinct gap be felt in the trachea. An immediate free opening into the trachea is indicated, and gives the only chance of saving the patient.

Wounds of the neck.—Clean wounds made by the surgeon in the various operations on the neck, such as the ligature of arteries or the removal of tumours, heal without difficulty, even when the deepest structures in the neck have been opened up, provided that all bleeding has ceased before the wound is closed, that firm compression be applied, and the part kept at rest. The use of a drainage-tube will be advisable for a few hours if any after-oozing is anticipated.

Wounds of veins.—The large veins are much more likely to be wounded by accident or necessity than the arteries. Glandular and other tumours have often a very close connection with the internal jugular vein. The danger of hæmorrhage from this vein is easily overcome by ligature, unless it is wounded or torn high in the neck close to the jugular foramen.

Owing to the intimate connection in the neck between the veins and the fascia and to the influence of the respiratory movements, a wound in a vein in this region may remain patent, and *air may be sucked in*. This alarming and dangerous accident is most likely to occur during the removal of a deeply-placed tumour, and when parts are put on the stretch by traction on the tumour. The suction sound made by the intruding air is very characteristic, and air bubbles may be noticed in the wound. The patient becomes immediately collapsed, with feeble running pulse, and embarrassed respiration. Pressure must at once be made on the opening in the vein, and restorative treatment applied to the patient, the opening being secured by ligatures so soon as conditions permit. This rare accident can be best avoided by substituting chloroform for ether when the respiratory movements in the neck are excessive; by carefully clamping all veins, however small, before section; by avoiding undue traction on the tumour to be removed; and when parts are being separated at a great depth in the neck, keeping a little fluid at the bottom of the wound (p. 504, Vol. I.).

Wounds of arteries.—A wounded artery in the neck must be treated on general principles, and a ligature placed above and below the opening. When the internal carotid is wounded close to the skull, and this procedure is not possible, a ligature should be applied to the internal carotid. If the common carotid be tied, a ligature should also be applied around the external—since the anastomosis between the branches of the external carotid with those of the same vessel on the opposite side is very free. In any case of punctured wound of a large vessel in the neck, the wound must be freely enlarged; pressure can then be maintained to arrest the hæmorrhage, whilst search is made for the bleeding point.

Wounds of nerves.—Injury of the sympathetic nerve, if sufficient only to irritate it, will cause dilatation of the pupil, and possibly

some protrusion of the eyeball; if the nerve is paralysed the pupil will be contracted, the eyeball retracted, and the secretion of sweat on that side of the head and neck interfered with. Injury to the phrenic nerve as it lies on the scalenus anticus will cause paralysis of one half of the diaphragm, difficulty in taking a full inspiration, and inability to force down the abdominal viscera and to protrude the belly wall on the same side. With section of the pneumogastric nerve the pulse becomes irregular and quick, and the action of the heart turbulent.

Cut throat.—Suicidal wounds are almost always incised, and are often lacerated, with jagged edges. They are commonly made from left to right, and obliquely downwards, or transversely across the neck. Their most common position is at or near the thyro-hyoid membrane. At the time of infliction the head is thrown back, and the larynx made prominent; the main vessels are in consequence protected by the state of tension of the sterno-mastoid muscles, so that they often escape injury; but the lingual and superior thyroid arteries are apt to be wounded in some part of their course. Very frequently tentative incisions in the skin will indicate the commencement of the incision, and if a blunt instrument is used the parts may be greatly hacked, and portions of the hyoid or thyroid cartilage even removed.

Treatment.—The treatment of a cut throat case must be directed first to the arrest of hæmorrhage, and the prevention of suffocation; and then to the careful cleansing and disinfection of the wound, and the approximation by suture of such parts as are considered safe in the particular case. If the trachea be opened, and general oozing is going on, it will be well to insert a tracheotomy tube, and lightly plug the wound round the tube with gauze. In cases of great collapse from loss of blood, an injection of saline fluid into a vein of one of the extremities may be of great service.

Wounds in the thyro-hyoid region are apt to involve the attachments of the epiglottis; sutures should then be carefully applied to preserve its proper connections. If any difficulty in breathing ensue, from swelling above the vocal cords, a laryngotomy or high tracheotomy must be performed without delay.

If the larynx or trachea has been completely divided, sutures may be employed with advantage to prevent retraction. Care must, however, be taken to provide for sufficient breathing space in front. There need be no hesitation about using sutures for the approximation of the ends of the skin incision if proper care is taken to provide for efficient drainage. (Wound of the œsophagus with its treatment is described at page 549.)

Apart from the immediate effects of the injury, the *chief dangers* in cut throat are from general depression, cellulitis, and septic pneumonia. The wound is inflicted in very unfavourable circumstances; there is often delay in the first dressing, and difficulty in getting the parts clean and aseptic. The patient is in a depressed or

alcoholic state; resists treatment, and wishes to die. When the wound of the air-passage is free, blood enters the bronchial tubes, and during the collapsed state of the patient is not coughed up, and, later, septic discharges from the wound make their way into the air-passages, and tend to induce septic pneumonia.

The patient must be placed in a warm room, and carefully watched; it is most important to maintain the strength, and when fluid food cannot be readily taken, or excites cough, nasal feeding should be resorted to. The healing of the wound must be encouraged by maintaining a suitable position of the head. If the patient survive the immediate effects of the injury, recovery must not be despaired of, even under the most unfavourable conditions.

The *remote effects* may be serious, such as permanent contraction of the air-passage, aphonia, and aërial fistula. *Fistulæ* are not common, and are due to loss of substance, to great retraction of the divided parts, or to occlusion of the air-passage above.

Cellulitis of the neck may occur in an acute diffuse form, especially after septic wound, or after scarlatina. The inflammation may arise in any of the planes of cellular tissue, and the effects produced will vary with the position of the pus as regards the enclosing layers of cervical fascia. Thus the inflammation may spread into the axilla or into the mediastinum. The whole side of the neck may become involved, and if the inflammatory products are allowed to remain confined, serious pressure on the trachea or great vessels and nerves of the neck may result.

Treatment.—Early relief of tension is most important, and incisions must be made in the middle line, or along the anterior or posterior borders of the sterno-mastoid; the deep fascia must be opened, and search by director or forceps be made for pus, which may be found by the sides of the trachea or around the carotid sheath.

Acute abscess frequently depends upon acute inflammation of the lymphatic glands, especially those which have absorbed septic material from the mouth and throat; the connective tissue around the glands then becomes infected, and an acute phlegmonous inflammation thus ensues.

Angina Ludovici is a form of submaxillary cellulitis, dependent on a specific poison. It commences with general constitutional disturbance—rigor and high fever, rapid swelling in the submaxillary region, due to oedema of the connective tissue. The swelling encroaches on the mouth, pushing the tongue upwards and backwards, and causing difficulty in swallowing and in breathing. The disease runs a rapid course, producing great depression, and often ends fatally in a few days from septic intoxication, or the patient may be attacked early with oedema of glottis, and die suddenly, unless relieved for a time by tracheotomy.

Treatment.—An early incision should be made in the middle line; the swollen connective tissue will be found to be infiltrated with offensive fluid or thin pus; such early free drainage and warm antiseptic fomentations afford the only chance of recovery. A

somewhat similar acute septic inflammation occasionally occurs in the connective tissue around the pharynx and larynx, in connection with erysipelatous inflammation of the throat.

Acute abscess.—As examples of other forms of acute abscess in the neck may be mentioned—(1) Suppurative periphlebitis, due to septic thrombosis of the internal jugular vein, the thrombosis in the vein being an extension from the lateral sinus. Ligation of the vein below the infected part and the free evacuation of the pus have saved many patients threatened with pyæmia, and some in whom the pyæmic infection had already declared itself.

(2) Abscess from acute necrosis of the lower jaw.

(3) Abscess from necrosis of the cartilages of the larynx.

(4) Abscess in the neck by extension from acute inflammation in the axilla or mediastinum.

The acute and chronic abscesses in the post-pharyngeal region are referred to in Article XLV., page 535.

Chronic abscess of the neck.—Chronic abscess in the neck is of common occurrence, and is more usually the result of continued irritation in the glands of young subjects, or of persons in a weak state of health; it is especially apt to follow scarlet fever or measles. Very frequently a chronic abscess is dependent on tuberculous adenitis; the suppuration then begins in one or more of the glands, bursts through the capsule, and infects the surrounding tissues. Such an abscess may undermine the skin, and appear to be superficially placed; but on evacuation of the pus an aperture is frequently found in the fascia, through which the pus has made its way, and the remnants of the diseased gland will be found more deeply placed in the neck. The treatment of such abscesses will be found on p. 670, Vol. I.

Chronic abscess in the neck may receive communicated pulsation from a large artery, and thus simulate aneurysm, or even occasionally ulcerate into an artery, or more rarely into the internal jugular vein.

An empyema may present in the neck, and in exceptional cases an abscess in the posterior triangle may depend on a tubercular disease of the apex of the lung.

TUMOURS OF THE NECK.

A great variety of tumours is found in the neck. Those in connection with the parotid and thyroid glands will be referred to when dealing with the affections of these glands (pages 369 and 371).

Mode of examination.—In examining a tumour it is important to determine whether it is superficial to, or beneath the deep fascia, and to ascertain its relation to the sterno-mastoid muscle. When deeply placed even a small tumour may exercise considerable pressure effects on the vessels, nerves, and air- or food-passages. The question of innocence or malignancy must be determined by general

considerations, but the desirability of removal will depend largely on the mode of commencement, the amount of fixation to surrounding structures, the pressure effects, and the probability of complete removal. If the tumour be movable above the main vessels it may generally be extirpated. It is, however, sometimes impossible to determine the relation to the deeper structures until an exploratory incision has been made, and the deep fascia divided.

Solid tumours of the neck.—

The solid tumours include lipoma, fibroma, chondroma, osteoma, glandular tumours, tumours of muscle, hernia of lung.

A **lipoma** may be found in any part of the neck, but is more common at the back of the neck and in the sub-maxillary region. Occasionally it is congenital in origin, or develops in young subjects. Fig. 676 represents a soft encapsuled lipoma just below



Fig. 676.—Fatty Tumour of Neck in a young Girl.

the chin in a girl fourteen years of age; the swelling had been there since infancy. Sometimes a lipoma is of the diffuse form, and may attain a large size and occasion great disfigurement, as in Fig. 677. This condition is often associated with a history of indulgence in alcohol. At the back of the neck symmetrical tumours are occasionally met with, and give rise to the appearance seen in Fig. 678. Lipomata in this position are often devoid of capsule, and are intimately adherent to the surrounding tissue.

Fibromata are rarely seen in the neck, but may occur in connection with the ligamentum nucha.

Chondromata, if we leave out of consideration those occurring in connection with tumours of the salivary glands, are rare, but may

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Fig. 677.—Diffuse Lipoma, from case by Mr. Roger Williams. (Pathological Society's Transactions, 1879.)

develop from remnants of cartilage in the position of the branchial clefts.

An **osteoma** occasionally grows from the transverse processes of the cervical vertebræ, and may cause pain by pressing on nerves, or may press on the vessels. A rudimentary cervical rib may easily be mistaken for an exostosis.

Glandular tumours are exceedingly common in the neck. For a detailed account of the various glandular swellings and their treatment reference must be made to the Article on "Diseases of the Lymphatics" (p. 662, Vol. I.).

Distribution of the lymphatic glands.—The superficial cervical glands situated along the external jugular vein may become enlarged, secondary to conditions affecting the scalp, skin of face, and the external ear.

The submaxillary group of lymphatic glands may enlarge from affections of the lower lip, anterior part of the tongue, gums of the lower jaw, and other parts of the buccal cavity.

The lymphatic glands in the parotid region enlarge from affections of the frontal and parietal parts of the scalp, and adjacent parts of the skin of the face, and the upper portion of the pharynx and parts of the nasal fossæ.

The mastoid and suboccipital glands receive lymphatics from the posterior part of the scalp.

The deep cervical glands surrounding the carotid vessels may be divided into an upper and lower group. The upper set enlarge from affections of the buccal cavity, the posterior portion of the tongue, the tonsils and palate, the lower part of the pharynx, the larynx, orbit, and roof of mouth and nasal fossæ. The lower group, situate about the lower part of the internal jugular vein, extend outwards into the supra-clavicular fossa, and become continuous with the axillary and mediastinal glands, and receive lymphatics from the œsophagus. The retro-pharyngeal glands may enlarge from affections of the pharynx and nasal fossæ.

The very large surface from which the lymphatics end in the cervical glands explains the frequency of acute and chronic adenitis in the neck. Glandular swellings secondary to inflammation of the parts from which the apparent lymphatics proceed are, as a rule, easily diagnosed; the enlarged glands may at first be movable, but if the swelling persists the tumour soon gets fixed to surrounding parts. Very often, however—and particularly in children—a



Fig. 678.—Symmetrical Fatty Tumours at the back of the Neck.

glandular enlargement is due to a comparatively trivial source of irritation, and depends greatly on the general depreciation of health. The diagnosis between such a condition and a primary tuberculous inflammation of the glands is often very difficult, and can only be arrived at by watching the progress of the case—after eliminating all sources of continued irritation, attending to defects in sanitation, and placing the patient under the best conditions for improving the general health.

Tuberculosis of glands.—A tumour composed of a number of tuberculous glands may remain for a long time free from any active inflammatory signs—such as heat, redness, involvement of the coverings, or fixation to the surrounding structures (Fig. 679). When, however, such a glandular swelling persists, and especially if there is a tuberculous family history, it is best to excise it. A section of the glands will give clear indications of their character, by showing evidence in some part of caseation. When these tuberculous glands have become fixed to important structures, like the internal jugular vein, it is often best to be content with enucleating the contents with a scoop, and not to attempt the complete removal of the capsule.

Tuberculosis of the lymphatic glands is much more common in the neck than in any other part. No doubt the tubercle bacilli have a constant chance of entrance through abrasions of the face, ear, scalp, or throat. For a time the invasion may be limited to a single gland or group of glands, and the disease may be eradicated by early and complete removal. The operation is most simple if undertaken before peri-glandular inflammation has commenced, and before many glands have become successively infected.

Tuberculous glands in the neck are always a source of danger. They may apparently remain quiescent for a long period, or even shrink and appear to subside, but at any time active local extension or general tuberculosis may take place. If the tuberculous process has involved many glands and extended to the surrounding tissues, removal by operation becomes a formidable procedure, and unlikely to be complete; indeed, interference may sometimes cause a traumatic dissemination, or the operation wound will early show signs of infection. When the recurrence is entirely local, a fresh attempt may be made to eradicate the disease; and it is not uncommon to have to operate several times before a cure is effected.

Lymphoma.—The neck is a common situation for lymphoma, or non-inflammatory glandular hypertrophy. When the general health is not involved, and the swelling is confined to a single group of glands, and is of moderate size, the diagnosis from a tuberculous affection is sometimes impossible. If, however, the tumour reaches to a considerable size, and the glands remain free and distinct (Fig. 680) and unattended by any inflammatory symptoms, the probability of lymphoma is considerable. Operation is then comparatively easy; after a free incision over the tumour, the glands can be shelled out with the finger or the handle of a knife, but unfortunately

the result is often disappointing, and tumours appear in other parts of the lymphatic system. In the case shown in Fig. 680, the patient, a boy of twelve, died two years subsequent to operation, from general lymphadenoma.



Fig. 679.—Tuberculous Glands of Neck.

Syphilitic enlargement of the glands in the neck is common, particularly at the time when throat affections are present. (*See* p. 398, Vol. I.)

Epithelioma of the lips, tongue, larynx, and œsophagus are commonly attended by **secondary deposits in the cervical glands**. The affected glands may at first be movable, but soon become adherent to the surrounding structures. The glandular enlargement is generally

irregular, painful, and hard; degenerative changes take place in the centre, and in some cases a gland is thus converted into a malignant cyst. The glands may be enlarged secondarily to carcinoma or sarcoma of the salivary glands, and particularly to lympho-sarcoma of the tonsil.

Primary carcinoma of the lymphatic glands of the neck is said occasionally to arise, but on careful inquiry some primary source of infection will almost invariably be found.

However, in rare instances, squamous-celled carcinoma of these glands has been observed without any primary lesion being present, an occurrence which is comparable to those rare examples of chimney-sweep's cancer of the glands of the groin, in which no affection of the skin of the scrotum was discoverable. Fig. 681 is from a photograph of a patient with malignant disease of glands, secondary to epithelioma of tongue. Tracheotomy was necessary, owing to tracheal pressure.

Tumours of muscle.—The sternomastoid muscle is especially prone to be the seat of gummatous infiltration, but a congenital tumour or induration of this muscle is not infrequently noticed shortly after birth, as a result of injury



Fig. 680.—Lymphadenoma of Neck, from Boy under the care of Mr. Clutton.

during birth. In most cases there is a history of breech presentation or difficult labour. A syphilitic history is often absent, and the swelling subsides without treatment, but may occasion a shortening of the muscle, and be followed by wry-neck. (See pages 7 and 39.)

Hernia of the lung into the neck is of very rare occurrence, but may suddenly develop in children during a fit of crying or coughing. The Fig. 682 is from a photograph of a child fifteen months old; the swelling suddenly appeared in the posterior triangle of the neck, on the left side, during an attack of hooping-cough. The swelling was soft when the child was quiet, but became large and tense on crying or coughing. Breath sounds were plainly audible over it, and were vesicular in character; but the tumour was not resonant on percussion, or crepitant to the feel. The child was, at the time of the occurrence, weakly and still at the breast. The case was sent to St. Thomas's Hospital by Mr. Brown, of Ealing, to whom the author is indebted for the photograph. Careful compression was maintained for



Fig. 681.—Pressure on Trachea by Epitheliomatous Glands, necessitating Tracheotomy.

several months over the tumour without much effect, but as the child grew stronger the swelling began to decrease, and at the end of twelve months had entirely disappeared.

The condition is due to a rupture of the fascia covering the dome of the pleura, and is said to take place generally on the left side, and to be capable of cure by compression.

Cystic tumours of the neck.—The following may be met with:—

- (1) Congenital multilocular cysts, or cystic hygroma.
- (2) Unilocular cyst, or hydrocele of neck.
- (3) Simple sebaceous cysts.
- (4) Deep atheromatous or dermoid cysts.
- (5) Bursal cysts.
- (6) Cysts developed in connection with the lingual duct.
- (7) Blood cysts.

(8) Malignant cysts.

(9) Cysts in connection with the air- and food-passages.

Mention may also be made of hydatid cysts, and the cysts which develop in connection with the thyroid or salivary glands.

1. The **congenital cystic hygroma** (Fig. 683) consists of a series of cysts irregularly spread through a bed of fibrous tissue. The cysts are lymphatic spaces, and have an endothelial lining. These tumours are congenital in origin, and when they occur in the neck, although apparently situated in the subcutaneous tissue, they usually send off deep processes—especially around the vessels and trachea. They may attain a very large size, and prove fatal by compression of important structures. The tonsil may be involved, and if its enlargement interferes with breathing, must be excised. Hygromata are liable to attacks of spontaneous inflammation, and after such attacks some absorption may take



Fig. 682.—Hernia of Lung into the Neck.

place, and the swelling thus undergo a form of spontaneous cure. Removal by dissection should not be lightly undertaken; the tumour has no capsule, and the exact limits are difficult to define. When there are deep processes their removal would be attended with great risk, and in some cases be impossible. On the other hand, by waiting there is a very fair prospect of spontaneous cure; or the cysts may be tapped, and reaction set up by the injection of iodine or Morton's solution.

2. The **unilocular cyst or hydrocele of neck** (Fig. 684) may be congenital, and of the nature of a cystic hygroma, but it not uncommonly first makes its appearance manifest during childhood or early adult life. The favourite situation is in the posterior triangle of the neck. If tense it gives a firm, almost solid



Fig. 683.—Cystic Hygroma of the Neck. (From a case at the Sick Children's Hospital, Great Ormond Street, London.)

feel to the hand ; it is seldom sufficiently prominent to be translucent. The cyst is thin-walled, and may have a bluish opalescent colour. The usual treatment is by tapping and injection. If favourably placed it may be dissected out, but this is not easy, since the wall is very thin and adherent to, or rather a part of, the surrounding structures.

3. The **ordinary sebaceous cysts** present no special peculiarity in the neck. (See page 181.)

4. The **deep atheromatous or dermoid cysts** arise from the inclusion of small masses of epiblast, either near the midline or in the sites of the branchial clefts. A common position is between the genio-hyo-glossus and mylo-hyoid muscles ; the tumour then presents as a rounded swelling between the jaw and the hyoid bone, encroaching on the floor of the mouth, and projecting beneath the mucous membrane. When these cysts occur on the side of the neck they are usually in close relation to the carotid sheath and the pharynx. The dermoid contents consist of fatty debris and epithelial cells. (See p. 490, Vol. I.)

The only satisfactory treatment is by extirpation, and this can usually be accomplished without risk by careful dissection. Treatment by incision and drainage is very unsatisfactory, and will be followed by a persistent discharging sinus.

5. **Bursal cysts** occasionally develop by the side of the larynx, or an enlargement of the bursa at the top of the thyroid cartilage may occur. If the swelling persist, it may readily be excised.

6. **Cysts developed in connection with the lingual duct.**—His has described a canal running from the foramen cæcum, between the genio-hyo-glossi muscles to the posterior surface of the hyoid bone. This he terms the lingual duct.

This duct is continuous with the thyroid duct, which runs from behind the hyoid bone down to the isthmus of the thyroid body. A cyst may form beneath the tongue and between the genio-hyo-glossi muscles, which is developed from the ductus-thyro-glossus, and containing a brownish glairy fluid. Cysts may also be found below the hyoid bone in the midline, in close contact with the larynx and trachea; these cysts move on deglutition. They are thin-walled, with smooth lining membrane, and develop in connection with the remnants of the ductus thyro-glossus. These cysts are best treated by excision.

7. **Blood cysts.**—This heading includes aneurysm and certain



Fig. C84.—Unilocular Cyst of the Neck.

forms of *nævus*, which are described in Art. XXV., p. 585, Vol. I. Occasionally a simple cyst containing blood is found in the neck, which is developed in direct connection with a vein or venous plexus. It may, however, be one of the lymphatic cysts of the neck, into which hæmorrhage has taken place.

8. **Malignant cysts of the neck** occur occasionally as primary tumours. The subjects are of middle or advanced life, and the development of the swelling is rapid; and the diagnosis, before tapping, is that of abscess. The cyst wall has an infiltrating character, and has an inner smooth lining, or is covered with granulations presenting the histological characters of an epithelioma. The fluid contents vary, and may be mucoid, bloody, or purulent. These malignant cysts are deeply placed in close relations with the vessels, and often attain a large size and appear to be primary in character.* A somewhat similar cystic transformation is not unfrequent as a consequence of secondary epitheliomatous deposit in the glands of the neck. The explanation of the development of epitheliomatous cysts as a primary condition is not easy, but they may owe their origin to some included portions of epiblast at the site of the branchial clefts, or to some of the glandular tissue near the thyroid cartilage, which is supposed to be accessory to the thyroid gland.

9. **Cysts having a communication with the trachea or food-passage** are occasionally met with.

The *tracheocele* may be either congenital, or develop later by hernial protrusion between the rings during coughing or violent expiratory effort; but probably there is some pre-existing congenital defect in the tracheal wall. The tumour would be compressible, in direct relation with the trachea, and a tracheal murmur would be audible on auscultation.

The cystic swellings in connection with the *œsophagus* are described at page 546.

Congenital branchial fistulæ.—These fistulæ result from the incomplete closure of the branchial clefts, which should be completely closed at the end of the second month of fœtal life. These fistulæ frequently communicate with the pharynx, and are occasionally hereditary—the peculiarity running through several generations.

They are usually on the right side, behind or in front of the sterno-mastoid muscle; more rarely they are on both sides of the neck, or in the middle line. The external orifice of a fistula, which will probably only admit a fine probe, may be found under a fold of skin, or covered by a few granulations. A viscid secretion escapes, and a cord-like thickening may be sometimes traced in an upward direction towards the hyoid bone. In some cases the external orifice is indicated by a tag of skin, containing a portion of cartilage derived from the branchial arch. The wisest treatment is to let such a fistula alone, and not irritate it by hot wires or attempts at

* See paper by Mr. Treves in the Pathological Society's Transactions, vol. xxxviii.

excision. If the external part were induced to close, a cyst might develop from the retention of secretion.

AFFECTIONS OF THE PAROTID GLAND.

Parotitis.—The parotid gland is liable to an infective inflammation, with a distinct period of incubation. This form of parotitis—or, as it is more commonly called, *mumps*—affects chiefly young subjects, and at times is epidemic in character. It runs a definite course, and is attended with great swelling, difficulty in opening the mouth, and febrile symptoms. The swelling may occur on both sides; it subsides in a week or ten days, and very rarely ends in suppuration. In 2 or 3 per cent. of the cases orchitis arises as a complication, and may be followed by atrophy of the testicle. Occasionally a swelling of the testicle first shows itself, followed in a day or two by the characteristic parotid enlargement. The breast, or uterus and ovaries may become inflamed in girls, but the complication is a very rare one.

Acute inflammation of the parotid gland or parotid bubo may arise during the course of typhoid, scarlet fever, measles, or small-pox; it may develop during septicæmia after child-birth, or follow ovariectomy or other abdominal operation.



Fig. 685.—Adenoma of the Parotid Gland.

Suppuration is very likely to take place, and early evacuation of the imprisoned matter will be urgently required.

Care must be taken to avoid wounding the facial nerve or parotid duct—the incision being made parallel with these structures, and the matter, if deeply placed, must be reached by means of a director, and the opening afterwards dilated with dressing forceps in the way advocated by Hilton.

Gangrenous parotitis is a rare condition, and attended with widespread destruction of the parotid tissue.

Affections of the parotid duct.—Steno's duct may become obstructed by a *calculus*, which should be removed by an incision on the buccal surface. If such a calculus is allowed to remain, a cystic dilatation of the duct will form, and be likely to open on to the cheek, leaving a *salivary fistula*. This may become chronic and difficult to close, especially if the duct in front of the opening has become partially or completely obliterated by inflammatory adhesions.

A parotid fistula may result also from wound, burn, or ulceration secondary to abscess in the parotid, in the lymphatic glands in the neighbourhood, or secondary to disease of the jaw. Such a fistula will not close so long as any obstruction of the natural passage

exists, and much irritation and inconvenience will arise from the escape of salivary fluid during mastication. Small fistulæ in connection with the gland structure readily close, but a chronic one of the duct is often very difficult to treat. Careful dilatation of the duct from the orifice in the mouth must be attempted, and, if necessary, a seton of wire or silk be introduced. When the natural passage is established the fistula can be treated by a plastic operation. (See also page 491.)

Tumours of the parotid. **Adenoma.**—Simple adenoid tumours of the parotid are not common; they occur in young

adults, are encapsuled, and may arise in any part of the gland, but do not grow to any large size; small cysts are frequently found in them (Fig. 685). These tumours can generally be enucleated without difficulty, by incising their capsule.

Fibro-chondroma.

—Far more frequently the slow-growing parotid tumour is complex in structure, and consists of fibrous and glandular tissue, and often contains more or less hyaline cartilage, the matrix of which sometimes undergoes myxomatous change. These tumours commence on the surface, or more deeply in the substance of the gland;



Fig. 686.—Large simple Parotid Tumour.

they grow slowly and without pain, are elastic in feel, and may attain a large size. When large they are bossy in outline; the skin is stretched over them, but not adherent. Surrounding structures are pushed aside by the encapsuled tumour, and simple pressure effects are alone produced, and the general health does not suffer. The facial nerve is rarely paralysed; the tumour extends towards the surface, and may become almost pendulous in character. This is well shown in Fig. 686; the man was a postman aged 37, he had had the tumour for many years. He was admitted to St. Thomas's Hospital, under Sir W. MacCormac, and the tumour was shelled out without the slightest difficulty. A simple tumour in the parotid region may, however, have deep connections, and its removal be attended with considerable risk, both to the facial nerve and the adjacent blood-vessels.

Sarcoma.—In some instances a parotid tumour, after a very

slow development, and perhaps a long period of apparent inactivity, may suddenly take on rapid growth, and begin to infiltrate the surrounding structures, involve the skin, fungate, etc. Such a tumour would show, on section, spindle cells and sarcomatous changes, in addition to the original complex structure.

Carcinoma.—A soft quickly-growing tumour in the parotid region, occurring about middle life, is probably sarcomatous in character, but may be a soft carcinoma. A hard ill-defined tumour appearing in a person past middle life, fixed to surrounding structures, attended with shooting pain up the side of the head, facial paralysis, ulceration or commencing involvement of the skin, and implication of the neighbouring lymphatic glands, would present all the characteristics of a primary carcinoma of the parotid.

Treatment.—The innocent parotid tumour, when (as is generally the case) it is superficially placed, can be safely removed by a longitudinal incision over the course of the vessels, and a transverse one parallel to the facial nerve and duct. Care must be taken in doing the deeper dissection, and a director used in preference to the knife. In some of the larger simple tumours the facial nerve is so situated in the growth that injury to it may be unavoidable. Occasionally a small tumour, placed just below and in front of the tragus, may give rise to considerable anxiety in this respect. Malignant growths, whether sarcomatous or carcinomatous, so early implicate the important adjacent structures, and the deeper processes of the gland are so intricately and remotely situated, that a satisfactory removal is almost impossible, and, if successful, is likely to be attended with speedy recurrence. If, after careful consideration, it is thought well to attempt the removal, very free incisions should be made, and all vessels clamped, if possible, before division.

DISEASES OF THE THYROID GLAND.

Atrophy of the thyroid gland.—Atrophy of the thyroid gland accompanied by overgrowth of its stroma may occur, and it produces the remarkable disease called *myxædema* (Fig. 687), a condition closely resembling a *cretinoid state* (Fig. 688); the chief symptoms of both being slowness of speech and intellect, the characteristic appearances of face, neck, and extremities produced by the resistant subcutaneous swelling, the lowering of the body temperature, *anæmia*, and other signs. It was shown by the investigations of the Committee of the Clinical Society that the condition of *myxædema* is identical with the *cachexia strumapriva* observed so often after the removal of the goitrous gland in the human being, and the normal gland in monkeys; and these conclusions have been made still more certain of late by the administration of the thyroid gland as a food, or medicinally in the form of an extract, both to the cretin and to the subjects of the acquired disease.

Though the phenomena which result from the non-development

or congenital-fibroid derangement of the gland, and its removal by operation, are characteristic and well established, yet the exact function of the thyroid gland is by no means certain, and is still a subject for inquiry.

Goitre or bronchocele.—Goitre or bronchocele is any enlargement of the thyroid gland not caused by inflammation.

The thyroid consists of closed vesicles, lined by a single layer of cubical epithelium, and containing a clear albuminous fluid. These vesicles are held together by areolar tissue, supporting numerous blood-vessels, and the gland is surrounded by a definite capsule.

The gland in the female



Fig. 687.—Myxoedema in a Man.

frequently enlarges during pregnancy, and sometimes during menstruation, and the term congestive goitre is applied to such temporary functional enlargement.

Varieties.—The term *simple bronchocele* or *parenchymatous goitre* is used when all the constituents are relatively enlarged (Fig. 689); *fibrous goitre* when the chief increase is in the fibrous stroma; *pulsating goitre* when with simple hypertrophy there is a great dilatation of the vessels; *cystic bronchocele* when the cavities are unduly distended with fluid (Fig. 691). If several of such distended cavities coalesce a large cyst may result, and occasionally an intracystic growth occurs.

Secondary changes may also be found, such as the substitution



Fig. 688.—Cretin.

of gelatinous colloid material for the clear fluid, or in very chronic cases a calcification of the cyst walls. The encapsuled tumours are frequently cystic, and by coalescence of the cysts and the disappearance of the septa a unilocular cystic swelling of large size may result.

A goitre may, therefore, be a general enlargement or a special enlargement of a particular part of the gland, and it may be soft or



Fig. 689.—Solid Bronchocele in a young Girl. It almost disappeared under treatment with iodide of potassium.

firm, be composed of a number of cysts, or consist of one large unilocular cyst.

Ætiology.—Bronchocele occurs in all climates, but exists in an endemic form in certain places, especially the valleys of mountainous districts—*e.g.* Switzerland and certain parts of India. In England it is most common in Derbyshire, but sporadic cases arise in all localities, and it is often difficult to assign any special determining cause. No doubt in some there is a hereditary tendency. It has already been mentioned that a congestive enlargement may occur during pregnancy or menstruation, and it is common to find some enlargement of the gland in anæmic women and girls, and this enlargement may become permanent.

Diagnosis.—The diagnosis is generally made without difficulty, since the swelling is in such close relation with the trachea, and moves

with it so distinctly during the act of deglutition. A swelling confined to one lobe has been mistaken for aneurysm, receiving strong pulsation from the carotid, which it overlaps; and certain vascular bronchoceles have such an active independent pulsation, that a little difficulty in the diagnosis may occasionally arise. There is, however, almost always some enlargement of the isthmus, and the swelling can usually be raised from the artery. It is not always so easy to make out whether a goitre is cystic or solid, fluctuation is so easily simulated by soft elastic growth, and in some cases only an exploratory tapping will settle this point.

Special forms of goitre.—The following special varieties of goitre can only be briefly referred to:—

- (1) Acute goitre.
- (2) Congenital goitre.
- (3) Substernal goitre.
- (4) Exophthalmic goitre.
- (5) Malignant goitre.

1. **Acute goitre.**—Goitre is usually of very chronic formation, but occasionally—especially in young subjects—it develops very rapidly, and as the fascia of the neck has not had time to stretch, dangerous pressure symptoms are especially apt to occur. In this form of the affection the thyroid gland may undergo such rapid enlargement as to attain the size of the fist in the course of a few days or weeks.

2. **Congenital goitre** is very rare, but a few cases have been recorded where successive children born of a goitrous mother have shown signs of enlargement of the gland at birth. The swelling, however, has usually quickly subsided, so that at the end of three or four months the condition of the neck has been nearly normal.

3. **Substernal goitre.**—A goitre may increase in a downward direction, so that it makes its way between the manubrium and the trachea. A distinct encapsuled swelling may be found in this position, which has either developed in some accessory thyroid tissue or has wandered from a higher position.

4. **Exophthalmic goitre.**—The enlargement of the thyroid is attended with protrusion of the eyeballs, palpitation, marked pulsation in the carotids, anæmia, and general weakness. The protrusion of the eyeballs may be so great as to cause ulceration of the cornea from exposure. The thyroid swelling often consists of a general soft hypertrophy, with increase and dilatation of the blood-vessels. The swelling consequently pulsates, and is often tender to the touch. This disease nearly always occurs in women, and there has generally been noticed some preceding deterioration of health. With improvement of the health the disease may gradually vanish, but often it gives rise to continued distress, and may end fatally. Nothing is known as regards the exact pathology of the affection, but it is believed to depend on disturbance of the sympathetic system.

5. **Malignant goitre.**—Cancer of the thyroid is rare; it

generally involves the whole gland, but does not grow to any large size. The lymphatic glands in the neighbourhood are early infected, and the recurrent laryngeal nerves become implicated in the growth. A button-like excrescence in some cases makes its way into the trachea, and hæmorrhage from the trachea, with signs of tracheal obstruction, may be the first indications of the thyroid disease.

It is not very common for cancer to appear in the thyroid as a secondary deposit.

Sarcoma is even more rare than carcinoma as a primary disease; it generally occurs in connection with some old-standing goitre, may grow to a large size, and cause marked pressure symptoms. Encapsuled at first, later it infiltrates the surrounding structures and shows signs of a local rather than a general malignancy.

Several cases have been recorded where, secondary to an enlargement of the thyroid body, pulsating tumours have appeared in the bones, presenting microscopically a structure very similar to that of normal thyroid tissue.

Local effects caused by bronchocele.—A thyroid may attain slowly an enormous size, without causing any difficulty in breathing. The trachea may be considerably displaced, or laterally compressed; its cartilages may become absorbed, so that its walls assume a membranous character, and may thus easily fall together. Symptoms of stenosis of the trachea are most commonly due to lateral compression, the lumen becoming triangular in shape, with the rounded apex of the triangle looking forwards; this alteration is most marked opposite the isthmus. This compression is most commonly met with in the more rapid thyroid enlargements. In substernal goitre the trachea may be flattened from before backwards. Dyspnoea may be noticed on exertion during the day, but the attacks often occur suddenly during sleep, and may be occasioned by a collection of mucus, or possibly by a bending of the softened trachea, with flexion of the head during sleep. Often the patient is afraid to go to sleep, or wakes up in a fright from a sense of impending suffocation. Sometimes during sleep the breathing becomes so noisy as to be heard at a considerable distance. A fatal suffocating attack may occur quite suddenly, and without previous warning.

The cystic form of goitre is liable to sudden enlargement from intracystic hæmorrhage, from inflammatory engorgement, or from rupture of a cyst, and dyspnoea may thus suddenly arise, and the condition become urgent. Laryngeal spasm is not common in the simple forms of goitre, but may be present at an early period in malignant disease. Compression of the œsophagus occasionally occurs, but is rare in comparison with tracheal pressure.

A goitre may also occasion fulness of the superficial veins, and pressure on and outward displacement of the carotids. The internal jugular veins may be drawn inwards by their connections with the thyroid veins, and their normal relations with the carotids thus considerably altered.

Treatment.—The treatment of bronchocele will best be considered under the following heads: general measures; operative measures; treatment of solid goitre, of cystic goitre, of exophthalmic and malignant goitre, and of urgent dyspnoea with goitre.

General measures.—A patient suffering from thyroid enlargement should be placed in healthy and bright surroundings; attention should be paid to the general condition of health, and the anæmia, if present, treated by preparations of iron, arsenic, or suitable tonics. In some cases iodide of potassium given in large doses has a remarkable effect in diminishing the size

of the swelling (Fig. 689). Iodine may be used as a paint over the swelling, or the biniodide of mercury in the form of ointment of the strength of ʒij to 1 lb. of lard may be rubbed lightly over the swelling every night before a hot fire. In India this ointment has been used with great success, the patient's neck being exposed after the application to the rays of the sun. Unless carefully applied, the treatment is apt to occasion considerable irritation of the skin.

Operative measures.—When a uniform enlargement of the thyroid is not increasing in size, and is unattended by any pressure effects, it should not hastily be interfered with by operation; and in no circumstances should the whole gland



Fig. 690.—Enlarged Thyroid with Pressure Symptoms. Cured by removal of the isthmus.

be removed, since the risk of myxœdema making its appearance has been shown to be considerable.

The treatment by injecting irritants into the gland substance, or by passing setons through the tumour, is now universally condemned, since the risks are considerable, and the results extremely uncertain.

When the enlargement is localised, and believed to be an encapsuled adenoma, it may be possible to enucleate it; and this procedure is specially advisable when there seems a danger of the tumour getting substernal in position, and is likely later to cause dangerous compression.

Treatment of solid goitre.—When, however, with a solid general enlargement there are signs of tracheal pressure, operative interference is generally indicated. The simplest method, and one which is often attended with a very satisfactory result, is to remove, or even merely divide the isthmus. The effect is to

relieve the compression produced by the binding of the two halves of the thyroid together; and further, it is frequently followed by a rapid diminution of the general enlargement.

Thus, in the case of general parenchymatous goitre, shown in Fig. 690, the patient, a young man, had noticed a steady increase in the size of his neck for two or three years, and signs of tracheal pressure for several months. Removal of the isthmus entirely relieved the distress of breathing, and a rapid diminution in the size of the lateral lobes quickly followed the operation.

When the enlargement is mainly of one lobe, the combined removal of the isthmus and the affected lobe would appear to be the best operative measure to adopt.

The chief dangers are from hæmorrhage at the time of operation; wound of the recurrent laryngeal, or its inclusion in a ligature; difficulty in breathing during the necessary manipulations, due mainly to traction on the trachea when the head is thrown back; cellulitis of the neck, from failure of aseptic precautions, or from ineffective drainage of the large cavity left. When the dissection involves the tissues behind the manubrium, an inflammation may arise in the loose tissue of the anterior mediastinum, causing pain, rapidly-increasing dyspnoea, feebleness of pulse, and speedy death.

Reference must be made to a work on operative surgery, as to how best to conduct the operation so as to avoid these dangers.

When difficulty of breathing occurs during the operation, the head must at once be raised, and tracheotomy, if possible, avoided, since an opening in the trachea is a very fatal complication, causing the wound to become septic, and likely to be followed by broncho-pneumonia.

It follows, from what has been said of the possible risks, that operative interference for goitre should not be lightly undertaken for the mere improvement of personal appearance.

Treatment of cystic goitre.—Cysts have been successfully treated by tapping, and the injection of a solution of iron or iodine. The cannula is left *in situ* under antiseptic dressings until suppuration has been induced; it is then withdrawn, and a drainage-tube inserted. This method is, however, attended with some risk, either by the accidental tapping of a vein or by extension of the inflammatory process.

The treatment now usually adopted is by exploratory incision.



Fig. 691.—Unilocular Cyst of Thyroid cured by Incision and Drainage. After operation a small sinus remained for about twelve months.

If the cyst is single it may, in certain cases, be excised, and a satisfactory result thus be at once obtained. When, from its vascularity, or the difficulty of enucleation, this is not thought advisable, it will be safer to incise the cyst, and drain it; when necessary, lightly packing the cavity with antiseptic gauze to arrest the hæmorrhage (Fig. 691). Unfortunately, a complete cure is slow, and a discharging sinus may remain for months, or even several years. When several cysts are present, the removal of the affected lobe is the most satisfactory procedure.

Treatment of exophthalmic goitre.—For the general treatment of this condition reference must be made to a work on medicine. Occasionally operative interference may become necessary when there is tracheal pressure. Some improvement in the general symptoms, as well as diminution of the thyroid swelling, has undoubtedly followed removal of the isthmus in a few cases. The goitre is usually very vascular, and the general circulation defective. The dangers attending operative interference are out of proportion to the chances of possible improvement.

Treatment of malignant goitre.—Malignant disease of the thyroid must, with rare exceptions, be regarded as unfit for removal. In carcinoma, by the time the diagnosis is established, the growth will be fixed, and the lymphatic glands almost certainly affected.

If sarcoma is recognised before infiltration has taken place, the affected lobe should be removed, but early recurrence may unfortunately be expected.

Treatment of sudden dyspnœa with goitre.—Before concluding the subject of treatment, it is necessary to refer briefly to the sudden and dangerous attacks of dyspnœa which sometimes take place when the tracheal wall is pressed upon. If the goitre is solid, and the case too urgent for treatment by ice and leeches, an incision should be made in the middle line, dividing the fascial coverings and exposing the isthmus, which should then be divided. Tracheotomy is very difficult, owing to the displacement of the trachea and its concealment by the growth, and should be avoided if possible. In great emergency an opening might be made above the isthmus, and tubage of the trachea tried. If the goitre be cystic, and the symptoms be due to sudden increase of pressure, the cysts should be incised.

When the goitre is malignant, the difficulty in breathing may be due to spasm of the larynx, and be relieved by laryngotomy. But if due to direct pressure of the tumour, a low tracheotomy will give the only possible chance of prolonging life.

AFFECTIONS OF THE LARYNX.

Scalds of the larynx.—These accidents are of not uncommon occurrence amongst the young children of the poorer classes, and are caused almost invariably by the little ones inhaling steam when attempting to drink from the mouth of a kettle.

In the years between 1872 and 1893, seventy-eight cases of scalds of throat were admitted to the wards of St. Thomas's Hospital; and in sixty-seven, "drinking from spout of kettle" is put down as the cause of the accident; in four of the remaining cases the cause is stated, "drinking from spout of teapot." The average age of these children was three years.

Burns affecting the larynx are rare, but may arise from the inhalation of flame, as from the upsetting of a paraffin lamp, or from the attempt to swallow a corrosive fluid.

Symptoms.—A scald of the larynx is always attended with some signs inside the mouth and pharynx; the parts looking congested, or white and corrugated, and occasionally there is a coating of actual membrane. The immediate symptoms of shock and pain are soon followed by difficulty of respiration, due to œdema of the epiglottis and aryteno-epiglottic folds. If this swelling persists, the breathing becomes difficult and noisy, with retraction of the lower rib cartilages. The face becomes livid, and the patient, unless relieved, may die quite suddenly, or gradually become unconscious and asphyxiated.

Treatment.—The treatment most commonly employed is to put the patient in bed, and keep the air moistened by a steam spray. In some cases the application of ice to the throat may be tried with advantage. If œdema of the glottis is evident, relief may occasionally be afforded by scarification, but the necessary manipulations are not easy in young children, and tracheotomy had better be resorted to without delay, since a very fair prospect of recovery is thus afforded. Out of twenty tracheotomies at St. Thomas's Hospital for scald of larynx in children, eight recovered. Six cases were treated by intubation, with three recoveries. In the three fatal cases where intubation was tried, tracheotomy was afterwards done as a last chance. Neither tracheotomy nor intubation was performed unless the difficulty in respiration was serious and likely to prove fatal. Although young children with scald of larynx frequently die after tracheotomy from exhaustion and broncho-pneumonia, it is very wrong to delay the operation until the conditions are desperate, for not only is the operation discredited, but many lives are thus lost which might be saved by more timely interference.

œdema of the glottis.—This condition, which takes place so frequently after scald of the throat, may arise secondarily to any traumatism in the neighbourhood—such as the sting of a wasp, impaction of a foreign body, wound of the base of the tongue or epiglottis, after cauterisation of the larynx or endo-laryngeal operation, from fracture of hyoid or larynx, or bruise of the same. It may arise in the course of Bright's disease, or as a complication of measles, scarlet fever, small-pox, etc. It is apt to occur in both the acute and chronic forms of laryngitis, especially when the inflammation is of septic origin. œdema of the glottis may also arise during the course of any laryngeal or pharyngeal ulceration, whether due to syphilis, tubercle, or carcinoma.

The effusion may be serous, sanguinolent, or purulent, according to its origin, and is limited to the submucous tissue of either side of the epiglottis, the aryteno-epiglottic folds, and the upper or inner surface of the larynx, rarely extending below the cords, where the close adhesion of the mucous membrane to the perichondrium does not favour such effusion. However occasioned, the swelling diminishes the breathing space, and gives rise to acute or chronic difficulty of respiration. The condition is easily recognised by the laryngoscope, and the severer forms can be distinctly felt by the finger.

Laryngitis.—The various forms of laryngitis may be classified under the following headings :—

Simple acute and chronic catarrhal laryngitis.

Acute œdematous or submucous laryngitis.

Tuberculous and syphilitic laryngitis.

Perichondritis.

Simple membranous laryngitis.

Diphtheritic laryngitis.

Acute catarrhal laryngitis arises either from extension of a pharyngeal catarrh, or as a primary condition occasioned by cold, or the inhalation of irritants, and is especially apt to occur in those who indulge to excess in tobacco or alcohol. It is rare in children, and most frequent in adult males. It may be acute or subacute. There is usually some fever, and constitutional disturbance, tenderness about the larynx, and hoarseness of voice, increasing in some cases to aphonia. Constant efforts are made to clear the throat, and there is present a little mucous expectoration. Redness and swelling of the mucous membrane of the larynx, and particularly of the cords, is to be seen by the laryngoscope.

Under treatment the symptoms speedily improve, but may persist in a chronic form. The acute condition is not generally attended with great difficulty of breathing, but in severe cases, spasm of the glottis or considerable swelling from submucous œdema may arise, and urgent symptoms present themselves.

The *treatment* of acute catarrhal laryngitis is by keeping the patient in bed, with ice applied to the throat; or by the inhalation of steam, medicated with the comp. tincture of benzoin 3j to Oj. Leeches externally are occasionally of great service. Laryngotomy or intubation will be necessary if dangerous signs of suffocation arise.

Chronic catarrhal laryngitis may result from an acute attack, or be caused by constant vocal effort. The chief characteristics are huskiness of voice and constant desire to clear the throat, with evidence of congestion, with perhaps a little swelling on laryngoscopic examination. A granular condition of the pharynx is a frequent association.

The *treatment* is by complete rest of the voice, and change to a dry bracing atmosphere, with the application of various astringents by the spray, or the direct application by the brush of a strong solution of nitrate of silver gr. xx to 3j.

Acute œdematous laryngitis.—It has been shown that a sudden œdema of the larynx may occur from many causes, but the primary acute inflammatory form is fortunately rare, and is erysipelatous or septic in character. The mucous membrane appears red, pulpy, and swollen, and the subcutaneous tissue infiltrated with inflammatory exudation. There is severe constitutional disturbance, the fauces are dusky and swollen, swallowing is generally difficult, and the voice, hoarse at first, is soon reduced to a whisper. There is tenderness over the region of the larynx, and some external swelling of the neck often quickly makes its appearance. The struggle for breath is very severe, and may be terminated by sudden spasm. If the breathing is relieved by treatment, the patient is very likely to die in a few days from exhaustion and typhoid symptoms.

Treatment.—Scarification is generally recommended, but in most cases the powers of the patient will be best preserved by laryngotomy or a high tracheotomy. The general powers must be sustained, and if there be any sign of abscess within the throat, it must be opened. More often, if supuration occurs, it is in the loose tissue around the larynx or pharynx.

Tuberculous laryngitis is nearly always associated with pulmonary disease, and the larynx is affected as a secondary complication. Very active and fatal disease, however, of the larynx occasionally runs its course, with but slight signs of lung trouble; and tuberculosis of the larynx may even show itself as a primary condition. The diagnosis in the early stages is often made clear by the peculiar pyriform swelling of the mucous membrane covering the arytenoid cartilages, and by associated pulmonary trouble. When ulceration has taken place it may be difficult to distinguish between the tuberculous and syphilitic forms. Tuberculous ulcers are usually numerous and of small size, and are found on the aryteno-epiglottic folds, false cords, and lower surface of the epiglottis. Syphilitic ulcers are more commonly situated on the upper surface of the epiglottis; the ulcers are often single, and rapidly extend in size and depth. Patients with tuberculous ulceration have usually much pain and difficulty in swallowing, but the process is not often attended with much obstruction of the glottis from œdema, so that tracheotomy is seldom required. When the ulceration is extensive, the cartilages may become implicated, and necrosis take place.

Treatment must be chiefly directed to the general state of the patient. Local applications may give some relief, but are not of much value.

Syphilitic laryngitis.—Syphilis may affect the larynx in the different stages of the disease, and, as may be expected, in a variable manner. As an early manifestation it may show itself as a laryngitis, improving only with constitutional treatment. Sometimes mucous patches, attended with superficial ulceration, may be seen.

In the later stages a gummatous infiltration occurs, and may be

distinguished from tuberculous nodulation by the history, the position, and the colour, the tuberculous nodules having a pale grey tint, whilst gummata are usually red, and darker than the normal membrane. When ulceration takes place the upper surface of the epiglottis is frequently involved, and evidence of characteristic ulceration or a cicatricial condition of the pharynx may be present. Cicatricial contraction in one part, and extending ulceration in another, is much more seen in syphilitic than in tuberculous disease of the larynx, and the behaviour of the ulceration under treatment is often of great value, when the diagnosis is perhaps otherwise obscure.

Extensive ulceration may be attended with necrosis of the cartilages of the larynx, and more or less permanent stenosis result.

During the progress of syphilitic laryngitis tracheotomy may be necessary for the relief of stenosis, due either to cedema of glottis, or to contraction following the cicatrization of healing.

Constitutional *treatment* must be actively employed, and local applications of mercury may be applied by the laryngeal brush, or in the form of a spray.

Perichondritis of the larynx may arise in exceptional cases as a primary condition, but far more frequently it follows injury, tuberculous, syphilitic, or malignant ulceration.

Typhoid fever, scarlet fever, and small-pox may be attended by necrosis of the cartilages, particularly the arytenoid.

In cases of progressive necrosis of the larynx external sinuses form,

and it may become necessary to perform thyrotomy in order to remove carious or necrosed parts of the cartilages.

Simple membranous laryngitis.—A simple membranous exudation in the larynx or trachea may result from scald or other traumatism.

By the term *croup* was formerly meant a simple non-infective, non-contagious membranous inflammation of the larynx, arising in children. Probably many of these cases were really spasmodic attacks of breathing, due to congenital adenoids, or some defect in the shape or working of the epiglottis. It is very doubtful whether such a form of idiopathic membranous laryngitis exists, and the term is now only used in a clinical sense to imply laryngeal obstruction with febrile symptoms in children.



Fig. 692. — Membranous Cast of Trachea and Bronchi, from a case of diphtheria. (From the London Hospital Museum.)

Diphtheria.—The terms *membranous laryngitis*, *membranous croup*, and *laryngeal diphtheria* are now used to indicate a disease, which may begin in the larynx or spread to it from the pharynx, and which is attended with the formation of a false membrane. This membrane consists of a tough and fibrinous exudation, in which pus corpuscles are incorporated as well as epithelial elements from the inflamed tissue beneath. The deep layer of the membrane is mainly composed of necrosed epithelium. The exudation may extend into the trachea or bronchi (Fig. 692 shows a diphtheritic cast from trachea and bronchi).

The bacillus.—Loeffler has isolated in pure cultivation from the membrane a special organism, which is believed to be the specific contagium. The discovery of the bacillus has a most important bearing, both on the diagnosis and treatment of the disease. After considerable experimental research, Behring found that animals can be made immune from the disease, and that the blood of such immune animals contains a substance (antitoxin) which obviates the results which follow the presence in the bodies of animals of the diphtheria toxin. In the early part of 1893 Behring published his first series of thirty cases of diphtheria in the human subject, treated by the serum of an immunised horse. This treatment has since been extensively tried, and the results obtained have been most satisfactory. The evidence is sufficient to warrant the hope that the serum inoculation will successfully combat one of the most fatal diseases of childhood. (See p. 32, Vol. I.)

Conditions of occurrence.—Under certain special favourable insanitary conditions the disease may arise in a sporadic form, but it more generally occurs epidemically, and like the eruptive fevers, varies considerably in the malignancy of type shown. With evidence of membrane in the throat or nares it is easy to form an opinion as to the nature of a laryngeal catarrh, but when the larynx is affected primarily the diagnosis must depend on a general consideration of the case. A laryngitis attended with albumen in the urine, inflammatory enlargement of the glands at the angle of the jaw, rise of temperature, and rapid pulse, is almost certain in a child to be diphtheritic in character, especially if diphtheria is prevalent at the time, or others in the house are suffering from bad throats.

Symptoms.—Diphtheritic laryngitis is usually preceded by several days of malaise. With invasion of the larynx the characteristic croupy cough, and huskiness of voice will be present. The choking fits are at first paroxysmal, and largely due to spasm, but with spread of membrane the dyspnoea becomes more constant, and the patient exhibits great restlessness and fights for breath. On inspection, a sinking-in of the lower part of the thorax will be noticed, together with a drawing-down of the larynx during inspiration. The accessory muscles of respiration are brought into active play.

The patient may die during one of the spasmodic attacks, or signs of carbonic acid poisoning may set in, with fall of temperature,

blue lips, cold sweats, and lastly, coma and death. Some patients show signs of great depression, and general poisoning of the system from the very first, and die suddenly from cardiac failure. The diphtheritic throats which sometimes occur during the eruptive fevers, and more particularly scarlet fever, are of a very malignant type, and frequently attended with extensive ulceration of the mucous and submucous tissue.

Treatment of diphtheria.—The dose of *antitoxin* (as prepared at the British Institute of Preventive Medicine) used for injection varies from 10 to 20 cc., and in severe cases this dose may be repeated on one or two successive days. Little or no effect is observable in the first twenty-four hours. At the end of that time the membrane may usually be seen to become thinner, and this thinning progresses up to total disappearance, a result commonly reached from three to five days after the first injection. At the same time the general condition of the patient shows progressive improvement, and the signs of diphtheritic poisoning decrease. When the patient is under the influence of antitoxin it is rarely that the membrane extends in the fauces: if it is confined in the first instance to the fauces it is rare for the larynx to be subsequently affected, and if the larynx is already affected and tracheotomy is rendered necessary, the laryngeal obstruction is of short duration and the tube may be speedily removed. It seems probable that by the use of antitoxin the general mortality of diphtheria may be reduced to 20 per cent. The deaths which occur are mainly due either to the late period at which the patients come under treatment, or to the supervention of lung disease over which the serum has no control.

The ill effects hitherto noticed are limited to the occurrence of a scarlatiniform, morbilliform, or urticarial eruption, and less commonly of pain in or around the joints. Both these phenomena may occur at any time up to three weeks after the first injection, and both may be accompanied by high fever, which need cause no alarm.

Local measures.—In considering the treatment of diphtheritic laryngitis, it is important to remember that we have to contend with a general as well as with a local condition. We have to guard against asphyxiation from laryngeal obstruction, extension of the disease to the lungs, exhaustion due to the struggle for breath and the inability to take nourishment, syncope from cardiac failure, and the complications which may arise during the convalescent period.

When membrane is present on the fauces or pharynx, the use of perchloride of mercury by means of a hand-spray would appear to be the most beneficial local application, and more reliable than the solutions of bicarbonate of soda or phosphate of soda. A mercury solution of the strength of 1 in 2,000, or even 1 in 1,000 can be employed without any signs of irritation or mercurialism being produced. In using the hand-spray it is necessary to employ a tongue depressor, so that the solution may thoroughly reach the

post-pharyngeal wall. The application should be made for two or three minutes every three hours, and in this way the spread of the disease to the larynx may in some cases be prevented.

Tracheotomy.—When the larynx is affected, it is most important in children to give surgical relief by *tracheotomy* or *intubation* before urgent symptoms arise, and before the patient is exhausted by the constant struggle for breath, or is depressed by carbonic acid poisoning. The disease does not so commonly cause serious obstruction in adults, and operative interference is therefore less frequently indicated.

As a general rule, relief should be afforded when there is decided recession of the lower chest wall, and especially when expiration becomes impeded. In most cases a high tracheotomy is to be preferred, and if done in time is attended with a fair chance of recovery. During the twelve years from 1880 to 1892 inclusive, 371 tracheotomies were performed at St. Thomas's Hospital for diphtheria in children, with 99 recoveries, or 27·6 per cent. At Great Ormond Street Hospital for Sick Children during the same period, 239 tracheotomies were performed, with 66 recoveries, or 27·6 per cent. Recently nine successive cases of tracheotomy for diphtheria performed at St. Thomas's Hospital have recovered: and this success may be fairly attributed to the employment of the antitoxic serum.

Since the diphtheria cases have been treated at St. Thomas's Hospital by antitoxin, there have been 49 tracheotomies, with 36 recoveries and 13 deaths. These results are most encouraging, and form a marked contrast to the results before the introduction of this treatment.

The percentage of recoveries during different years varied considerably, and this variation must depend on the virulence or mildness of the different epidemics. Even when a patient is *in extremis* from mechanical obstruction, tracheotomy may give a chance of life, provided the lungs are not implicated. In very young infants the prognosis is extremely bad, and intubation may well be considered as an alternative.

In tracheotomy for diphtheria the high operation is to be preferred, since it is easier of performance; there is less danger of hæmorrhage from veins, and of inflammatory extension to the mediastinum. The opening should be a free one, and the trachea cleared of membrane through the wound before the introduction of the tube. It is important that the tube should have a movable collar, and that the part within the trachea should lie easily on the axis of the canal, and not press in any way against the anterior wall. The air should be kept warm and moist with a medicated spray, and careful attention paid to the cleansing of the tube. The inner tube must be changed as often as the conditions of the secretions require it, and a clean feather dipped in antiseptic solution may be used with advantage for the cleansing of the outer tube. During the first day or two there is often difficulty in swallowing, and fluids may gain access to the larynx and trachea, owing to the epiglottis and

upper aperture of the larynx having temporarily lost their proper protective action. In such circumstances nasal feeding by a soft tube is invaluable. In a favourable case the tracheotomy tube may be left out in a week or ten days, but very often it cannot be dispensed with for a much longer period. In the majority of the fatal cases membrane will be found to have invaded the bronchial tubes.

Complications after tracheotomy.—The following complications may be briefly referred to—emphysema of the neck; diphtheritic infection of the wound; ulceration of the tracheal wall; diphtheritic paralysis; difficulty in dispensing with the tracheotomy tube.

Emphysema of the neck, extending sometimes to the face and body, is likely to take place when there has been much separation of the parts around the trachea, and when the tracheal opening and the external incision do not correspond in position.

Beyond introducing as large a tube as possible, no interference is necessary, and the swelling will soon subside.

Diphtheritic infection of the wound is a serious complication, and may occasion much sloughing of the soft parts, and even necrosis of the tracheal cartilages. The tube should be left out, or a soft rubber one be introduced, and warm antiseptic fomentations applied.

Ulceration of the trachea is the result of a badly-fitting tube, but may be largely induced by the special malignancy of the case. The most common position for pressure ulceration is the anterior wall, opposite the end of the tube.

Fatal hæmorrhage has in some instances arisen (especially after the low operation) from a pressure sore extending into the innominate vein. Hæmorrhage from the trachea does not always indicate local pressure; it may arise from the separation of diphtheritic membrane.

Diphtheritic paralysis.—During an attack of diphtheria, or during apparent convalescence, paralysis of certain special muscles may suddenly ensue. When the soft palate and pharyngeal muscles are affected the patient will be unable to swallow, or will be compelled to desist, owing to fluids finding their way into the trachea. The nasal tube must then be used, and the strength maintained by regular mechanical feeding. The paralysis is due to a specific neuritis of the nerves supplying the muscles.

Difficulty in leaving out the tube.—It is after tracheotomy for diphtheria especially that difficulty is often found in dispensing with the tube. Generally fright on the part of the child is the cause, and with tact and management this is soon overcome. As pointed out by Mr. T. Smith, there may be an impairment or complete loss of function of the muscles of the larynx, and a considerable time may elapse before the habit of breathing through the larynx is re-established. In certain cases an actual mechanical obstruction exists, through the development of granulation tissue, and later of cicatricial tissue at the lower aperture of the larynx, and an actual kinking may occur, the trachea below the cicatricial

part bending backwards and forming an angle with the larynx (Fig. 693). If such conditions have existed for a long time, very active measures will be necessary to restore natural breathing through the larynx. A thorough exploration of the parts should be made by an enlargement upwards of the tracheotomy opening, all granulation or cicatricial tissue removed, and intubation of the larynx be diligently persevered in, so that recontracture may be prevented.

Laryngotomy.—Laryngotomy, or the insertion of a tube through the crico-thyroid membrane, is an operation easily performed, and suitable for certain cases of laryngeal obstruction, where the presence of a tube is only likely to be required for a short time—as, for example, acute oedema of glottis in adults, whether arising from a traumatic cause or acute laryngitis; spasm of the glottis in tetanus, or aortic aneurysm; for sudden impaction of a large foreign body in the upper aperture of the larynx, or for removal of a foreign body from the larynx: as a preliminary to certain operations about the tongue or throat, in which it is desirable to prevent blood from getting into the air-passages by plugging the pharynx with a sponge.

Tracheotomy.—Tracheotomy has already been considered in respect to diphtheritic laryngitis. The high operation is required also in children for the conditions just mentioned as suitable for laryngotomy in the adult, and also for obstruction due to multiple papillomata of the larynx.

A low tracheotomy is to be performed for foreign body in the trachea or bronchus; to give rest to the larynx in certain cases of syphilitic, tuberculous, or malignant disease; and occasionally to relieve the breathing when there is direct pressure on the trachea by goitre or other tumour of neck. (Fig. 681 is from a photograph of a case where tracheotomy was done for pressure on the trachea by malignant disease of glands secondary to epithelioma of the tongue.)



Intubation of the larynx.—This measure may be employed both as a means of dilating chronic stenosis of the larynx, and as a substitute for tracheotomy or laryngotomy in certain special conditions.

When employed as a substitute for tracheotomy in diphtheritic laryngitis, intubation has in England few advocates, but has in a great measure superseded tracheotomy in America and some parts of Europe. Without entering into a discussion of the supposed advantages or disadvantages, it may be stated that the choice of procedure in diphtheria must be governed by—

- (1) The nature of the case.
- (2) The surrounding conditions.
- (3) The previous experience of the surgeon.
- (4) The consent of the friends.

(1) Cases of a malignant type—especially those which arise in the course of scarlet fever—are very unsuitable for intubation, owing to the great tendency to pressure sores from the continued presence of the tube. All cases with extensive membrane on the fauces are also best treated by tracheotomy, since, if intubated, the patients would breathe contaminated air.

(2) Owing to the liability of an intubation tube to be coughed out, it is necessary for the surgeon to be always at hand to replace it, and therefore intubation can only be satisfactorily employed in hospital practice. At the same time, in cases of emergency, the breathing can for a time be relieved by intubation, without skilled assistance or chloroform.

(3) It is important that the operator should have made himself acquainted with the method of procedure, and should have at least practised it on the dead subject. The right-sized tube must be chosen, and it must be introduced quickly, and without using any force.

(4) Consent might be obtained when permission to perform tracheotomy had been refused. When the friends have not been consulted, it would be right to give the preference to intubation.

Leaving the question of intubation in diphtheria as one still under consideration, we may state generally that *intubation is unsuitable for the following conditions* :—

- (1) Obstruction caused by presence of a foreign body.
- (2) Active ulceration (whether syphilitic or tubercular) of the larynx.
- (3) Obstruction caused by new growth, whether simple or malignant.
- (4) Obstruction due to pressure by goitre or other tumour of neck.
- (5) Obstruction by post-pharyngeal abscess.

Intubation may be useful, and in some cases preferable to tracheotomy, in acute oedema of glottis due to scald or acute laryngitis, and in all cases where the obstruction is likely to be of

short duration, and there is no evidence of associated chronic ulceration of the larynx.

It may be employed as a means of diagnosis when it is uncertain whether the dyspnoea arises from obstruction in the upper air-passages, or to some condition out of reach—*e.g.* bronchitis, or pressure from mediastinal tumour, etc.

Intubation is invaluable in the treatment of simple cicatricial stenosis of the larynx or upper portion of the trachea, whether this



FIG. 604.—Position of Child during Intubation, one nurse holding the child and another the head.

follow the healing of syphilitic ulceration, or be secondary to the continued presence of a tracheotomy tube.

The operation.—A set of O'Dyer's intubation instruments consists of a gag, five tubes with corresponding obturators, an introducer and extractor, with a scale to indicate the size of tube suitable for the age of the patient. The upper end or head of the tube rests on the ventricular bands, and its anterior part is bevelled to avoid pressure on the base of the epiglottis. One nurse can hold the child, but it is very desirable to have a second assistant to keep the head and gag in position.

Fig. 694 shows the relative position of surgeon, patient, and nurses. The operator, holding the introducer with the tube threaded in his right hand, feels with his left forefinger for the epiglottis, and hooking this forwards, must gently insert the end of the mounted tube between his finger and the epiglottis, and must then raise the handle of the introducer, so as to follow the axis of direction of the trachea, which extends immediately downwards from the tip of the forefinger. So soon as the tube is pushed home, the introducer, with attached obturator, is rapidly withdrawn, the tube during the withdrawal being kept in position by the forefinger.

The entry of the tube into the larynx is indicated by violent coughing, quickly followed by easy breathing. In intubating for acute conditions it is best to leave the thread, so that the tube can be withdrawn without the aid of the extractor. Large pieces of false membrane can be coughed up through the tube, and if it should become blocked it is almost invariably ejected, and temporary relief thus afforded. The tube may, however, require to be pulled out, and may also have to be speedily replaced. In any circumstances the tube should be removed experimentally on the fourth or fifth day.

When intubating for acute conditions, the surgeon must be prepared to perform tracheotomy at once if relief is not afforded, but unfortunately the prospects of recovery under such conditions are extremely bad. In intubating for chronic stenosis, and when the patient is accustomed to the process, the thread may be withdrawn, and the tube left safely *in situ* for a week, or even longer at a time. Feeding during intubation is often difficult; fluid nourishment is apt to get into the trachea, and excite cough. Various forms of artificial epiglottis have been tried, but have not proved satisfactory.

Semi-solid food may be given, but it is often refused by children. Fluids may in some cases be easily swallowed, by placing the patient in a position with the head lower than the body, and encouraging him to suck in this position from a bottle. If necessary, feeding by the soft nasal tube must be adopted.

Foreign bodies in the air-passages.—A loose body in the mouth may, by a sudden inspiration, be drawn into the air-passages; such an accident is most common amongst children. A pebble, bead, puff-dart, pin, or other similar body may, during play, or during a sudden fit of coughing or crying, be thus inspired. Food in both children or adults may “go the wrong way”—for example, a large piece of meat may get impacted beneath the epiglottis, or a portion of bone, or even fluid may accidentally get into the air-passages. The following may be mentioned as some of the more common accidents occurring in adults, namely, detachment of false teeth, particularly if worn during sleep; a tooth or part of a tooth during the act of extraction; regurgitated food during *anæsthesia*; a portion of sponge or other foreign substance during operations on the mouth or throat. Persons suspected of stealing coins or attempting to pass false coins or jewellery, in trying to swallow the

articles may very easily in their excitement suck them into the larynx. The cannula of an old tracheotomy tube may become detached, and fall into the trachea or bronchus. The fate of a foreign body thus drawn into the air-passages will depend largely upon its size, weight, and shape. It may rapidly produce death by completely blocking the air-way, or by exciting continued spasm of the glottis. It may lodge in the larynx, trachea, or bronchus, be ejected almost directly from either position, or be spontaneously ejected after a prolonged impaction.

The immediate symptoms produced when the accident occurs are a sense of suffocation, great distress in breathing, and an attack of spasmodic coughing. The patient in a marked case becomes cyanotic, and greatly frightened. Frequently the body makes only a partial entry, and the symptoms are transient.

Symptoms of lodgment in the larynx.—The symptoms and treatment must be considered according as the lodgment takes place in the larynx, trachea, or bronchus. Impaction in the larynx may take place in one of the ventricles, between the cords, or, as in Fig. 695, below the cords. A sharp body, such as a pin or fish-bone, may become fixed in the aryteno-epiglottic folds. Sometimes the vocal cords may be kept wide apart by the substance, so that plenty of breathing space is left.

After the initial paroxysm has subsided, the symptoms may be but slightly marked, though usually there is a marked alteration of the voice, some cough, and dyspnoea, with pain and tenderness about the larynx, and expectoration of mucus or pus. Laryngoscopic examination will usually reveal the foreign body, if present, in the larynx. A small body might be so embedded as to escape detection, but local inflammatory signs would then be seen.

At any time during a fit of coughing the body may be ejected from the mouth, or swallowed, or it may pass into the trachea or bronchus. Remaining in the larynx it is likely to cause ulceration, and may in this way occasion pneumonia and death.

Fig. 695 shows a pebble about the size of a horse-bean impacted just below the vocal cords. The patient was a child six years of age, and after the immediate symptoms of impaction had subsided, he remained comparatively well for a month: ulceration of the



Fig. 695. — Pebble impacted just below Vocal Cords. A, Ulcerated surface; s, pebble. (St. Thomas's Hospital Museum.)

mucous membrane then caused pneumonia, from which the child died.

The long-continued presence of a foreign body in the larynx is likely to cause permanent damage to the voice, and lead to cicatricial stenosis.

Treatment when in the larynx.—When a person is suddenly seized with a choking fit, from a foreign body believed to be lodged in the upper aperture of the larynx, examination of the throat should be made with the finger, and unless relief is thus afforded, laryngotomy in an adult or tracheotomy in a child should be at once performed. When the symptoms are not so urgent, a careful laryngoscopic examination must be made, and the mode of treatment will depend upon the character of the foreign body, and the position of its impaction. Needles, pins, or a fish-bone in the aryteno-epiglottic folds would be best extracted through the mouth by the aid of laryngoscopic inspection, and a smooth body, like a coin, may sometimes be thus removed from the larynx.

When, however, the body is irregular in shape, or impacted in the ventricle or below the cords, it is far better, in the adult, to make a free opening in the crico-thyroid membrane, and remove it by forceps thus introduced. In exceptional cases the incision may be made through the thyro-hyoid membrane, and extraction thus effected. In children a partial thyrotomy will be advisable, as least likely to be followed by after-troubles.

The rule will hold good in all cases, that directly the diagnosis is clear the body must be removed.

Symptoms of lodgment in the trachea.—The diagnosis of a foreign body in the trachea is usually easily made, since the patient is subject at first to recurrent attacks of suffocation, owing to the irritation of the glottis when the body is coughed up against it. Very soon, from being clothed with mucus, it becomes less movable, and may even get embedded in the tracheal wall. The evidences may be slight when the patient remains perfectly quiet, but if made to cough, a convulsive attack, accompanied by wheezing and rattling in the throat, is likely to take place. On auscultation of the trachea, when the body is not impacted, it may be heard moving up and down, there will be evidence of some obstruction to the passage of air, and sibilant rhonchi may be heard during inspiration, expiration, or both. At any time a fatal spasm of the glottis may occur, or the body may drop into a bronchus, so that there is urgent need for tracheotomy.

Treatment when in the trachea.—An opening low down in the trachea is to be preferred, and a careful search made, the sides of the opening being held apart with retractors. The body, if loose, will be expelled through the opening, and if impacted must be removed with forceps. If necessary, the bronchi must be explored with forceps, and if no result is obtained, sutures should be passed through the sides of the tracheal opening, and fastened behind the neck, so as to maintain the patency of the

opening. Inversion of the patient may then be safely tried. After successful extraction the tracheal opening may be closed by sutures, and primary healing thus effected.

Symptoms of lodgment in a bronchus.—With impaction in a bronchus the physical signs will vary according to circumstances. A small, smooth body—especially if heavy—is more prone to descend into one of the bronchial tubes than an uneven light one. The tendency of the body to pass into the right bronchus, rather than the left, has generally been ascribed to the fact that the septum at the bifurcation is somewhat to the left of the middle line. The right bronchus, however, more closely follows the line of the trachea. It is probable that foreign bodies find their way into the left bronchus more frequently than is generally supposed. There appears, indeed, to be a good deal of difference of opinion amongst the compilers of statistics as to which bronchus has the preference.

If a main bronchus is completely blocked, the proper respiratory sounds on that side are absent, and signs of collapse of lung, with retraction of the chest wall, will soon be manifest. If the bronchus be partially obstructed, a loud musical murmur is likely to be heard, with diminished breathing in the lung on the affected side. Pain and cough, with some blood-stained expectoration, are generally present. The affected side is at first resonant on percussion. If the impaction is in one of the secondary divisions, only a limited area of the lung will at first be affected. A body remaining impacted may at any time be ejected through the larynx during a fit of coughing, or it may traverse the lung, produce empyema, and be thus eliminated. Occasionally it becomes encysted, and remains quiescent. Inflammatory symptoms, however, more commonly supervene, and they may be localised or general. The usual mode of death is by pneumonia, with abscess or gangrene. Recovery when abscess forms is very rare, the patient dying with symptoms resembling acute phthisis—viz. exhaustion, offensive expectoration, high temperature, and sweating, with signs of a cavity in the lung.

Treatment when in the bronchus.—The indications for treatment are not nearly so plain as in a case of impaction in the larynx or trachea. If the patient is seen before inflammatory symptoms have occurred, inversion and shaking may be tried, and has proved successful, but the surgeon must be prepared for instant tracheotomy, since spasm of the glottis may at any moment take place. If the foreign body is a solid one—such as a coin, false tooth, or part of a tracheotomy tube—and its position can be localised, a free opening must be made low down in the trachea, and careful search made by appropriate forceps or stout wire, bent as seems best for the particular case. Even if the search is not successful at the time, there is a fair prospect of spontaneous ejection through the opening later. In exceptional cases the signs of abscess may be so localised as to warrant an exploration of the lung, but unfortunately the abscesses are frequently multiple, and placed most unfavourably for surgical interference.

Possible error in diagnosis due to gland affections.

—Enlarged and especially caseating mediastinal glands occasionally give rise to serious trouble in the following ways:—

- (1) By pressing on the trachea or bronchus.
- (2) By one or more glands ulcerating into the trachea or bronchus, and so causing obstruction, or one may even become detached and impacted in the larynx.
- (3) A suppurating mediastinal gland not infrequently is the

cause of a gangrenous pneumonia.

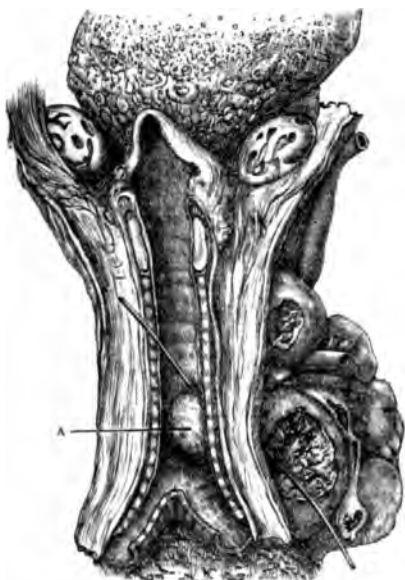


Fig. 696.—A, Portion of Caseating Gland which has made its way into the Trachea. The tuberculous gland abscess is near the bifurcation of the trachea.

Fig. 696 shows the larynx and trachea from a specimen in St. Thomas's Hospital. The child, aged four, died from an attack of dyspnoea, due to a caseous mass which made its way into the trachea from a tuberculous lymphatic gland abscess on the right side.

Attention has been drawn to these cases, since they must be taken into consideration in the investigation of a case where the history of the inhalation of a foreign body is not clear. In a child such a history is sometimes imagination on the part of the friends, and has nothing to do with the condition under consideration.

Innocent growths of

the larynx. — Papillomata and fibromata are the most common innocent laryngeal growths. Cystic swellings, myxomata, adenomata, lipomata, and angeiomata occasionally are found, but are very rare.

Papillomata may be sessile or pedunculated, solitary or multiple. They are most frequently situated on the vocal cords, ventricular bands, and aryteno-epiglottic folds. They may be congenital or develop in young children, and are then almost invariably multiple and recurrent in character (Fig. 697).

Fibromata exist singly, develop during adult life, are usually situated on a vocal cord, and are either sessile, or the attachment is only slightly narrower than the body of the growth.

Cystic swellings are globular and translucent, and most commonly occur as retention cysts on the epiglottis. Occasionally they

are congenital, and may be found on a vocal cord, and in other parts of the larynx.

Symptoms of innocent growths.—These innocent new growths sometimes occasion but slight symptoms, but generally produce hoarseness or some degree of aphonia. Dyspnoea occurs when the growth is sufficiently large to obstruct respiration, or during an inflammatory swelling of adjacent parts. Pain is seldom present. The diagnosis must rest on a laryngoscopic examination. In young children this may be extremely difficult, the view being entirely obscured by mucus, and in adults what appears to be a simple wart or fibroma may really be the early stage of a malignant growth.

Treatment of innocent growths.—In adults, papillomata and fibromata can generally be removed by the endo-laryngeal method, either by means of special forceps or by the laryngeal snare, and the base may be cauterised; but unfortunately papillomata are very frequently multiple, and extremely prone to recurrence.

Active interference with papillomata of the larynx in young children is not advisable unless dyspnoea is present. Not infrequently little is noticed wrong with a child beyond some loss of voice, until serious interference with respiration occurs, calling for immediate relief. Tracheotomy has then to be performed, and the diagnosis is not arrived at until the cause of the difficulty in leaving out the tube is investigated. It has been held by some that if tracheotomy be done, and the tube worn for some months or a year, so that the larynx is at rest, the tendency to the formation of these growths will die out, and that they will undergo a spontaneous cure. Such spontaneous cure is, however, so rare, that thyrotomy and the complete removal of every trace of growth is generally to be preferred. The difficulty of complete removal by the endo-laryngeal method is very great, and in most cases some of the growth is overlooked. Multiple papillomata in adults can be thus kept in subjection, but repeated operations are almost always necessary. Treatment by intubation is never advisable; the growths are likely to bleed, or to be irritated and inflamed, and made more difficult for subsequent removal. (See the section on Thyrotomy, page 397.)

Malignant disease of the larynx.—*Sarcoma* is a rare affection, and one very difficult to diagnose. If the sarcoma is



Fig. 097.—Laryngeal Papilloma.

circumscribed, and recognised sufficiently early by microscopic examination of a portion removed for the purpose by forceps, then inspection by thyrotomy and the complete removal of the growth must, when possible, be performed. The prognosis in such a case will be more favourable than in carcinoma, since the glands are not likely to be affected.

Epithelioma may invade the larynx by extension from the pharynx—epiglottitis or œsophagus—but it more commonly commences on the vocal cords or ventricular bands. When the disease invades the larynx by extension it is termed extrinsic, and when it develops primarily within the larynx, intrinsic. Carcinoma occurs most frequently in men, and between the ages of forty-five and sixty-five.

Symptoms.—The symptoms vary according to the position and extent of the growth, and whether the case is seen in an early or late stage. In some—particularly the extrinsic varieties—besides the evidences so far as the larynx is concerned, there will be found external thickening, enlargement, and fixation of the lymphatic glands, considerable pain in swallowing, and neuralgic pain not necessarily associated with deglutition or movement of the larynx.

In the intrinsic variety, for a long time the appearances and symptoms may be compatible with a benign growth. According to Semon, “epithelioma of the larynx often appears as a pale or pink-coloured wart, having a broad attachment to one or other vocal cord; after a time it is noticed that the cord is congested, and moves less freely than its fellow.” Very often, when the patient first comes under observation, the larynx is filled with an ulcerating irregular growth, and later the larynx will be noticed to be broader than normal, and very possibly this widening may be more marked on one side. If the patient lives long enough, the cartilages will become involved, and necrosis result. Death may take place at any time from laryngeal spasm or stenosis, septic pneumonia, or from exhaustion and inability to take food.

The diagnosis in the early intrinsic cases will rest between malignant and simple growth, and in the extrinsic cases and later forms of the intrinsic between syphilis and malignant disease. Neither from the symptoms or the laryngoscopic appearance is it always easy, or, indeed, sometimes possible, to be certain as to malignancy. When doubt exists, a portion of the growth should be removed by laryngeal forceps, and examined microscopically, and if epithelium be found to have invaded the connective tissue at the base of the growth, malignancy may be inferred; it is not, however, sufficient to discover cell nests. When ulceration is present, and the appearances are not sufficiently characteristic for diagnosis from syphilis, large doses of iodide of potassium should be given. Some slight temporary improvement under this drug may, however, take place, even in undoubted malignant conditions.

Treatment.—In many cases of malignant disease of the larynx, any radical operative treatment is out of the question. When there is evidence of interference with respiration, a low tracheotomy should

be performed, and life may thus be prolonged for a considerable period in comparative comfort, until widespread infiltration, perforation of the œsophagus, or other complications arise. (*See the following sections on Thyrotomy and Excision of the Larynx.*)

Thyrotomy.—Thyrotomy or the external exploration of the larynx is indicated as a means of diagnosis and treatment in all cases of doubt between a simple and malignant growth; for the removal of multiple papillomata in children; for the removal of a foreign body impacted in the larynx in children, and also in adults if sufficient access cannot be obtained by the free division of the crico-thyroid membrane; for the treatment of certain cases of necrosing perichondritis, and of cicatricial stenosis of the larynx.

A preliminary tracheotomy is generally advisable, and means must be taken to prevent any blood from passing into the bronchial tubes, either by use of a well-fitting tampon tracheotomy tube—such as Hahn's—or by packing the trachea above an ordinary tracheotomy tube with portions of sponge. All external bleeding must be arrested before the actual mesial division of the thyroid cartilage, and it is best not to carry this division to the extreme upper limit of the cartilage. With these precautions, an exploration of the larynx is free from any great risk, and in itself is not likely to be followed by serious defect of voice, provided that the parts are accurately adjusted by suture.

If a malignant growth is found, it must, if possible, be radically removed. Operative interference within the larynx is rendered much easier by the free use of cocaine.

Multiple papillomata are best removed with fine scissors curved on the flat, and each base of attachment should be touched with actual cautery or with chromic acid.

By introducing the forefinger through the mouth, the under surface of the epiglottis and the aryteno-epiglottic folds can be brought well into view, and great care must be taken to make the removal of the growths complete, since the tendency for recurrence is very marked. It has already been mentioned that a partial thyrotomy may be necessary for the removal of cicatricial tissue, causing stenosis just below the vocal cords, and due to the long-continued wearing of a tracheotomy tube.

In syphilitic stenosis, and after ulceration from diphtheria or foreign body, it may be necessary to remove the soft parts from one side of the larynx, in order to re-establish breathing through the natural channel.

Excision of the larynx.—Excision of the larynx or laryngectomy is indicated in selected cases of intrinsic malignant disease, where the condition is recognised sufficiently early, the disease is localised within the larynx, the external parts are unaffected, and the patient's condition is such as to warrant the attempt to extirpate the disease. When the lymphatic glands are involved, or there is evidence of implication of parts outside the larynx, the operation

becomes one of grave risk, and if not quickly fatal, will be certainly followed by a speedy recurrence.

A thyrotomy and complete inspection of the growth should always be first performed, and the further procedure then decided upon.

The most favourable condition is where the disease is limited to one side, and resection can be confined to one half of the larynx. The chances of recovery are not only far greater, but the after-condition may be extremely satisfactory, both as regards natural breathing and the preservation of an audible voice. After partial removal the patient will be able to dispense with the cannula, and can take food by the mouth within a few days of the operation. When the disease involves both sides of the larynx the choice of procedure is between the excision of the soft parts, leaving the cartilage box behind, and complete extirpation. Butlin has drawn attention to the late period at which the cartilages become affected, and is in favour of thus limiting the operation. The advantages of this method are that the patient suffers from less shock and immediate danger, and is able afterwards to speak in a whisper without the use of any artificial contrivance.

If complete extirpation of the larynx be reserved for cases where the disease already involves the cartilage, it becomes a question whether the risk is justified, since, if the immediate dangers of the operation are safely surmounted, recurrence in the great majority of cases may be expected in a few months, and the patient must either wear an elaborate artificial larynx, which is likely in itself to be a source of irritation, or else must be content with a simple tracheal cannula, and be exposed to trouble from saliva and food getting into the trachea.

Without entering into details as regards the steps of these different operations, it is important to remember that the chief dangers in such operations on the larynx are from broncho-pneumonia and purulent bronchitis, due to blood or food passing down the trachea, and septic cellulitis of the neck.

To avoid the first it is desirable to do the tracheotomy some days before the major operation, and so accustom the patient to the new conditions of breathing, and to take care that the trachea is efficiently shut off by the tampon, both during the removal of the larynx and for a sufficient time afterwards, so that food and suppuration products are entirely prevented from getting into the lungs.

The cavity left after removal of the growth must be packed lightly with antiseptic gauze, which should be changed daily, and the parts carefully cleansed and disinfected. Twenty-four hours after the operation, Hahn's tampon tube may be replaced by an ordinary tracheotomy tube wrapped round with iodoform gauze. The strength of the patient must be maintained by feeding through a soft rubber tube.

XLIV. THE SURGERY OF THE CHEST.

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In this Article the following subjects will be dealt with:—Injuries of the chest and their sequelæ and complications, the surgical treatment of diseases of the thoracic viscera, and certain surgical diseases of the chest walls.

INJURIES OF THE CHEST.

General considerations.—Injuries of the chest are of very frequent occurrence, present great variety, and are often of extreme gravity. They are caused by external violence of all kinds—falls, blows, cuts, stabs, bullets,—by internal injury, such as the inhalation or swallowing of a foreign body, and by muscular action. The effects of these injuries vary within the widest limits, according as they interfere with the function of the heart, great vessels, lungs, œsophagus, and thoracic duct, or impair the movements of respiration. They may be classified according to their causes, for these greatly influence their nature and progress.

Contusions produce the grave but obscure effects grouped under the heading of concussion, in which no gross lesion is found. They are also a fruitful source of bruises of the soft parts, of fractures and dislocations of the bones of the chest, and, when very severe, of bruising and rupture of the thoracic viscera. The injuries thus caused are often diffused over a considerable area, and they are specially liable to involve extensively or exclusively the chest walls. These, by their extreme elasticity, have a great power of resisting the effects of contusion, and of protecting the contained viscera. Contusions are rarely associated with an external wound, and are, therefore, almost entirely free from the danger of infective inflammation. If vessels of any size are wounded, the escaped blood, having no external vent, is liable to cause serious compression of the lungs or heart.

Stab wounds, cuts, and punctures cause limited wounds of the parietes, but often deep wounds of the thoracic contents. They are especially liable to be attended by profuse hæmorrhage.

Gunshot wounds of the chest are very numerous in military practice. They are characterised by the depth and extent of the internal lesion, and by the liability to lodgment of the bullet, or of some foreign matter carried in by it. Where there is an aperture of exit as well as of entrance, it is nearly certain that the bullet has taken a straight course from the one to the other. It has been stated that in some of these cases, where there is no sign of visceral injury, the bullet has been deflected by the ribs, and has passed round outside the ribs, and then pierced the skin. With the modern bullets this is certainly a very rare event, and absence of symptoms may be explained by the bullet having traversed the pleura without wounding the lung, or by its having inflicted only a very trifling injury on the lung.

Injuries inflicted by *foreign bodies in the air- or food-passages* have a very obscure and insidious onset. They sometimes run a chronic course, and at others cause sudden death, without any warning. In very many of these cases the foreign body carries with it infective pyogenic organisms, which excite suppuration.

Muscular action and strain are not often the sole cause of injuries of the chest. Generally some degenerative change has predisposed a rib to snap, or the heart to rupture. The effects produced are fracture of a single bone, rupture of a hollow muscular organ—the heart or œsophagus,—or a limited tear of a muscle.

It is interesting to notice some of the *special features of the structures of the thorax*, when viewed from a surgical aspect. Foremost among these is the impossibility of securing perfect rest for the injured parts. The functions of circulation and respiration cannot be interrupted, and their performance entails movement. Both the lungs and the heart are tolerant of injury, but their constant movement seriously interferes with repair. They are organs whose function is arrested by external pressure, and they lie in serous sacs in which air, blood, or inflammatory effusion readily collects. Again, the parietal vessels are difficult of access, and cannot readily be compressed on the cardiac side of a wound, as is the case in the vessels of the upper and lower limbs. When they are wounded, the blood is often drawn into the pleural cavity rather than projected from the wound. The main vessels within the thorax cannot be submitted to the ordinary surgical procedures of ligature, etc., and wounds of them are almost invariably at once fatal. From their position, injury of the œsophagus and thoracic duct from without is almost impossible. The association of several intra-thoracic lesions, or of thoracic with abdominal or other lesions, is very common.

Classification.—The best classification of the subject is partly anatomical and partly clinical, and we shall discuss injuries of the chest in the following order :—

- (1) Concussion of the chest.
- (2) Injuries of the soft parts of the chest walls and of the diaphragm.
- (3) Injuries of the bones and cartilages.

- (4) Injuries of the pleura and lung.
- (5) Injuries of the pericardium, heart, and great vessels.
- (6) Injuries of the œsophagus, thoracic duct, and mediastinum.
- (7) The sequelæ, or secondary complications of the above injuries.

The primary complications of these injuries—such as internal hæmorrhage, emphysema, etc.—will be dealt with under the heading of the injuries most often occasioning them.

1. Concussion of the chest.—In certain cases of severe concussion of the chest in which death supervenes instantaneously or after a very short interval, no gross lesion is found to explain this result. In other cases more or less severe symptoms persist for hours, or even a day, but the most careful physical examination of the chest fails to reveal any lesion to account for them, or the symptoms cannot be explained by the lesions present. The more or less grave symptoms in these cases are believed to be the result of concussion of the thorax.

Pathology.—The symptoms of concussion may be due to one or more of three or four causes. The first of these is direct *stimulation of the intra-thoracic branches of the vagus nerve*, leading to a general fall of blood pressure; the second is direct *concussion of the heart itself*, which may cause its sudden arrest in diastole. Severe blows upon the chest after division of the vagi nerves have been shown to cause marked fall of blood pressure, and the explanation of this effect lies in the concussion of the heart itself. The third possible cause is *paralysis of the sympathetic*, causing accumulation of the blood in the mesenteric and other abdominal vessels. Fourthly, the symptoms may be due to *anæmia of the brain*, resulting from the greatly lessened force of the heart and the fall in blood pressure.

Symptoms and diagnosis.—The symptoms, which vary much in their intensity and duration, come on immediately after the injury. The *pulse* is rapid, small, and weak; the heart-sounds are feeble; the cardiac impulse is scarcely, if at all, perceptible; the surface of the body is pale, cold, and bathed in sweat. The *respirations* may be very shallow, or very irregular in rhythm, a deep respiration being followed by a pause, and this again by a succession of shallow respirations. On listening over the chest, the breath-sounds are feeble, but otherwise normal. There is no abnormal dulness to percussion. In severe cases *consciousness* is lost. In slight cases recovery is speedy and complete. The diagnosis is based upon the history of the injury, and the absence of signs of coarse lesion.

Treatment.—As a rule, but little is needed. The patient should be placed flat in bed, and with his head low; his limbs should be rubbed; cardiac stimulants should be given, such as ammonia to the nostrils, ether subcutaneously, or brandy and water by mouth or rectum. Artificial respiration may be carefully employed. It is well to bear in mind that after prolonged and forcible artificial respiration air has been found in the heart and great vessels, the pleura and peritoneum, around the trachea, and in the subcutaneous tissues.

2. Injuries of the soft parts of the chest walls and of the diaphragm.

- (a) Contusions of the chest walls.
- (b) Wounds of the chest walls.
- (c) Wounds of intercostal and internal mammary arteries.
- (d) Wounds and ruptures of the diaphragm.

(a) **Contusions of the chest walls.**—The simplest cases are those of superficial ecchymosis and bruising, such as occur most often from falls. When the injury involves the muscles, their fibres are bruised and torn; this renders their contraction painful, and may embarrass respiration. The pain of a bruised muscle often simulates that of a broken rib, by its sharp character, and by its occurring with deep respiration or coughing. The diagnosis is made by noticing that pressure on the ribs at some distance from the injury does not cause pain, and that there is an absence of all deformity of the rib, of crepitus, and of the exquisite local tenderness of a fracture. Contusions of the muscles are frequently associated with fracture of the ribs, cartilages, or sternum, and with lesion of the thoracic viscera. An *abscess* in the chest wall may follow contusion.

The *treatment* of severe cases consists in securing rest of the injured muscles by strapping the side of the chest, or by lying in bed on the injured side. Where the pain of a bruised muscle persists—myalgia—a belladonna plaster or skilful massage will quickly remove it.

(b) **Wounds of the chest walls.**—These are of various kinds, and possess the features common to wounds in general. The special and grave results which may follow a wound extending into the pleura, make it important to distinguish those which are superficial to the parietal pleura—*non-penetrating*—from those which open the pleural sac—*penetrating*. When the lung is exposed or protrudes from the wound, or air is heard passing in and out of the wound with respiration, or blood is forcibly expelled with each cough or expiration, the fact of penetration is very evident. But it may have occurred without producing any of these symptoms, and therefore great caution must be observed. In such a case the wound may be gently explored by an aseptic finger, but not by a probe, lest it penetrate the undivided pleura. If the surgeon is still in doubt, he must wait and watch for signs of pleurisy, while using every care to secure an aseptic wound and its primary union.

Treatment.—Asepsis should be secured in the usual way, and the divided structures carefully united by sutures. Some delay in healing may be occasioned by the respiratory movements. Bullets impacted in the chest wall should be cut down upon and removed, together with any splinters of bone or portions of dress that may have been carried into the wound.

(c) **Wounds of the intercostal and internal mammary arteries** are caused by stabs and by bullets, but the intercostal vessels are so efficiently protected by the overhanging edge of the ribs,

along which they run, that they generally escape injury. Hæmorrhage from a parietal vessel is usually recognised by the blood flowing *per saltum*, uninfluenced by the respiratory movements, and unmixed with air; in the case of an intercostal artery, pressure with the finger against the lower border of the rib will stop the flow of blood. The blood from a wound of the lung is spurted out with each expiration and cough, mixed with air and without the characteristic arterial jet. Hæmoptysis is also usually present. But it is by no means always easy at once to distinguish parietal from visceral hæmorrhage, and the difficulty in making this distinction arises in two or three ways. In an oblique wound involving a parietal artery, the blood escapes in a continuous stream, and it may happen that a certain amount of air may be sucked in and mixed with the blood, which then comes to resemble the mixture of blood and air usually escaping from a wound in the lung. Again, if there is a valvular penetrating wound, or if the patient is making powerful inspirations, blood from a wounded parietal vessel may be drawn into the pleura, and then be expelled mixed with air with a cough or deep expiration. The resemblance to a case of wound of the lung is then very close. It must not be forgotten, too, that blood from a thoracic wound may come from both parietal and visceral vessels. To distinguish hæmorrhage from the parietes from external bleeding from the lung, Richter recommended that a folded card should be introduced deep into the wound with its concavity upwards. Blood from a wounded intercostal artery will escape along the channel of the card only, while that from the thoracic cavity will escape around the card also. A better plan, when doubt exists, is to hold the wound open with retractors—enlarging it if necessary—and expose clearly the bleeding vessel if it be in the parietes. There need be no hesitation in doing this, as it is essential for the proper treatment of the case. Another plan is to close the wound in the pleura by a sponge or tampon passed within the ribs; this prevents further escape of blood from the pleura, but does not hinder the flow from the intercostal artery. Blood from a wounded internal mammary artery may flow into the pleura or pericardium, or infiltrate the cellular tissues of the mediastinum. Wound of this artery is usually complicated by injury of the pleura, lung, pericardium, or heart.

Treatment.—The best treatment is to expose the bleeding vessel, and secure it in a pressure forceps or by a ligature. In the case of the internal mammary artery this is always very difficult, and may be impossible from the ends of the artery retracting beneath the costal cartilages. In such a case the wound should be enlarged, and a sufficient length of costal cartilage removed to gain access to the vessel, or it may be cut down upon and tied in the spaces above and below the one in which it is wounded. A tampon or plug should not be used.

In the case of an intercostal artery, three measures have been practised. By means of a curved needle a thread can be passed around the rib along which the wounded artery runs; by tying

this thread tightly the vessel is compressed against the bone. Or the periosteum over the rib may be divided longitudinally, and separated with a raspatory from the lower part of the rib; the periosteum will carry the vessels with it, and thus separated the wounded artery can be readily tied. The third plan is to shell out a portion of the rib from its periosteum and remove it; the wounded artery is then easily seen and tied. A tampon may be used, but if it is not well applied it merely arrests the outward escape of blood, and converts an external hæmorrhage into concealed internal hæmorrhage. To apply it properly, the centre of a piece of aseptic calico about ten inches square is passed deep into the wound beyond the ribs, the four corners remaining outside. Strips of boric lint or aseptic gauze are then packed firmly into this shell until it is full; by then drawing upon the corners of the calico firm pressure is made upon the intercostal artery. This method is not recommended, and should only be adopted where, from special circumstances, ligatures cannot be employed.

(d) **Wounds and ruptures of the diaphragm** are produced by stabs, gunshot wounds, and severe contusions of the chest, by violent vomiting, by injury from broken ribs, and by extension of rents in the lower end of the œsophagus. The injury is more common on the left side. It is usually associated with grave lesion of the thoracic or abdominal viscera. When not fatal from these complications, the wound in the diaphragm may heal, leaving a scar to which the lung adheres above, and the stomach or spleen below.

In some cases healing is prevented by a protrusion into the chest of some of the abdominal viscera, particularly the stomach, colon and omentum, more rarely the liver, spleen, or small intestine. Such a *diaphragmatic hernia* may become strangulated. The occurrence of congenital fissures and defects in the diaphragm, especially on the left side, must be borne in mind. The symptoms of diaphragmatic hernia are pain, dyspnoea, inability to lie on the affected side, displacement of the heart and lung, distension of one side of the chest, with abnormal hyper-resonance, and sinking in of the belly. Wounds of the diaphragm should be carefully closed with fine sutures.

3. Injuries of the bones and cartilages.

(a) Fractures of the sternum.

(b) Fractures of the ribs.

(c) Dislocations of the vertebral ends of the ribs.

(d) Fractures and dislocations of the costal cartilages.

(a) **Fracture of the sternum** is an uncommon injury; Gurlt found only 150 cases among 51,938 fractures; as it may pass unrecognised, probably it is not so rare as has been supposed. Its infrequency is explained partly by the cancellous structure of the bone, partly by the movement permitted between the manubrium and gladiolus and between these bones and the rib cartilages, partly by the cartilaginous condition of the xiphoid, but mainly by the extreme elasticity of the ribs and cartilages, and of the shoulder-girdle, on which the sternum rests.

Ætiology.—The sternum may be broken by direct or indirect injury, or by muscular action. Direct violence may be of the nature of a blow, a stab, or a gunshot wound. Indirect violence may over-bend or over-extend the bone, or may be applied to the outer end of the clavicle. A fall on the head with impaction of the chin against the sternum may break the bone. In the powerful contractions of parturition, in certain gymnastic feats, even in hanging by

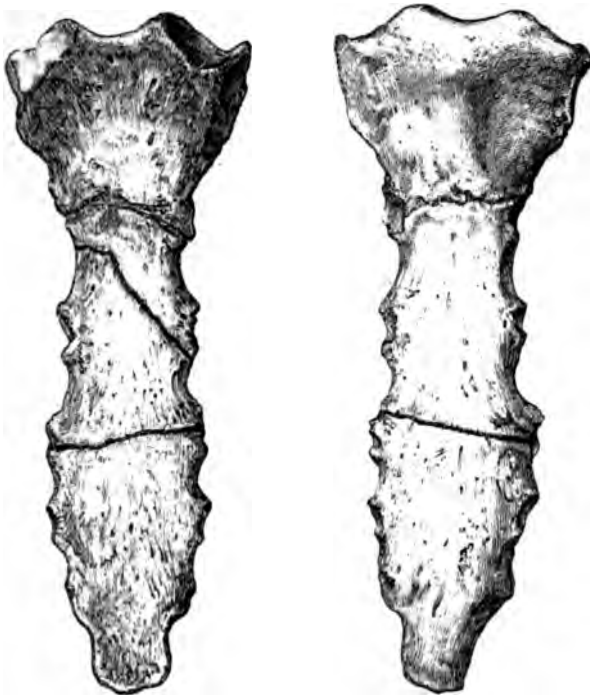


Fig. 698.—Sternum, showing two Fractures in the Gladiolus, one complete and transverse opposite the fourth costal cartilage, one incomplete and oblique involving the posterior compact lamina of the bone only. (From a specimen in the Middlesex Hospital Museum.)

one arm or violently extending both arms backwards, the bone has been broken; the muscles acting on the bone are the recti abdominis, the sterno-mastoids, and the pectorales majores. In fracture from injuries causing over-extension of the spine, it is possible that muscular action plays an important part. It has been stated that a fall on the feet or the buttocks may fracture the sternum by contre-coup; such fractures are probably due to muscular action. Pathological fracture occurs from caries and necrosis.

The fracture is usually transverse, but it may be oblique, or even vertical or comminuted (Fig. 698). Two cases of incomplete fracture, and one in which a fragment pierced the skin, have

been recorded. The anterior sternal membrane is probably always torn, but the posterior layer of periosteum is sometimes intact ; this is important, as it protects the mediastinum from extravasation of blood and from subsequent inflammation, and also prevents displacement of the fragments of the bone.

The most frequent site of the fracture is in the upper part of the gladiolus, between the second and fourth costal cartilages ; next to this between the manubrium and gladiolus ; the manubrium itself is rarely broken. There may be no displacement ; often the lower fragment rises forwards over the upper, and may lie on its anterior surface ; rarely the lower fragment is displaced behind the upper ; it has been found depressed nearly to the spine. The xiphoid cartilage when broken is most often displaced backwards ; it may, however, project forwards.

Fracture of the sternum in nearly half the cases is complicated with other injuries, among which may be specially mentioned fracture of the spine, skull, pelvis, lower limb, clavicle, or ribs, wound of the pericardium, pleura, lung, trachea, or liver, and extravasation of blood into the mediastinum, pericardium or pleura, pneumothorax, hæmoptysis, and so-called concussion of the thorax. Gunshot fractures are compound, and are especially liable to be associated with wound of viscera.

Fractures of the sternum in any part unite by bone in four or five weeks, even when complete displacement is not corrected ; several cases of ununited fracture have been recorded.

The *symptoms* of this injury are severe local pain increased by deep respiration or cough, tenderness, the displacement of the lower fragment, crepitus, and a certain amount of extravasation of blood around the part. These symptoms may be well marked, and the diagnosis easy ; when displacement and crepitus are absent, the nature of the injury, the seat and nature of the pain and tenderness and the local swelling will lead to a correct diagnosis.

The *prognosis* depends chiefly upon the accompanying injuries ; but death has been known to follow a fracture from muscular action. Union of the fracture with complete displacement, or ununited fracture, may be unattended with any important symptoms. Suppuration, caries, necrosis, and tuberculous disease may follow the fracture, even when not compound. Displacement of the xiphoid cartilage backwards may cause severe gastric pain and frequent vomiting.

The *treatment* consists in the full correction of any displacement and the support of the fragments until union is complete. The displacement is usually easily corrected ; if not, the body must be forcibly bent back over a large firm pillow, and the lower fragment pushed into place. Where this does not succeed at once the position of opisthotonos should be maintained, as after two or three days the displacement may be found corrected. Should this fail, it has been proposed to cut down upon the fracture and reduce it ; this should only be done when there are serious symptoms

of pressure either from a fragment of bone or from great effusion of blood. When the displacement has been corrected the patient should be propped nearly upright in bed with the head thrown well back; a broad piece of stout strapping should be applied over the broken bone, and a roller bandage carried around the chest, to limit the respiratory movements. If there is a great tendency for the displacement to recur, it may be necessary to keep the patient for a few days in a position of opisthotonos—bent back over a firm pillow.

Where there is fracture of the spine or serious injury of the skull, thorax, or abdominal viscera, this treatment cannot be carried out. If a displaced xiphoid cartilage causes pain and vomiting, it should be cut down upon and removed, or fixed in its proper position.

(b) **Fracture of ribs.** *Etiology.*—The ribs are especially protected from fracture by their own extreme elasticity—greater than that of any other bone in the body—by the still greater elasticity of the costal cartilages, and by the mobility of the sternum, to which the most fixed of them are attached in front. The clavicle and scapula with the thick muscles passing from the trunk to the upper limb also protect the ribs from injury. In spite of these safeguards fractures of ribs form 15 to 16 per cent. of all fractures, and occupy the third highest place in the list.

The cause of the fracture may be *direct violence*—the rib breaking at the point struck—such as severe crushing blows, bullet-wounds, and stabs; *indirect violence*—the rib breaking at a distance from the point struck—such as blows or falls upon the front of the chest, breaking the ribs near their angles; or *muscular action*, in coughing, sneezing, or parturition. The first rib may be broken by violence applied to the outer end of the clavicle. In infancy and childhood, owing to the very great elasticity of the chest, fracture of ribs is very rare; very considerable crushing force, as from falls from a height or the passage of a cart-wheel across the trunk, usually fails to break a child's rib, and the thoracic viscera may be seriously injured by such accidents without injury to the bones. When age leads to ossification of the costal cartilages, and greater hardness with less elasticity of the ribs themselves, fracture becomes more common. A special fragility of the ribs is occasionally met with in the subjects of general paralysis of the insane; the bones are atrophied, and break under very slight force. A rarefying osteomyelitis of the ribs leading to fracture from slight force, such as the muscular effort of coughing, has been described as occurring in young people; this accident is most frequent on the left side, and some old authorities used to ascribe the fracture to the heart's impulse.

Pathology.—The rib most often broken is the seventh, and the injury becomes less and less common as we pass upwards or downwards from this rib, until at either extremity of the series fracture is rare. The first two ribs are protected by the clavicle and scapula,

but cases are recorded in which one of these ribs only was found broken, and there is reason to believe that this fracture is not quite so rare as statistics would indicate, for the injury is very easily overlooked during life, and unless specially sought is liable to be missed *post mortem*. The floating ribs are protected from fracture by their extreme mobility and freedom from attachment in front, but they are



Fig. 699.—Section of a Rib at the seat of an old Fracture, showing "ensheathing callus."

most common seat of fracture; by different writers the anterior or the middle third has been stated to be the most frequent seat. The fracture is usually vertical and complete, but sometimes the inner or the outer table only of the bone is broken, and in stab wounds longitudinal splinters may be broken off. The periosteum may be intact, but more often it is partially torn across—on the surface towards which the rib is broken.

There may be no displacement at the seat of fracture. When caused by indirect violence, the bone is broken outwards; when caused by direct violence, the bone is broken inwards; but in either case the elasticity of the bone, the movements of respiration, and the action of the muscles fixed to the bone, usually restore the fragments to their original position. When several ribs are broken there may be considerable displacement, and in the case of double fracture of a rib the detached fragment may be drawn in with each inspiration and raised with expiration, causing a most striking deformity of the chest wall. Longitudinal displacement—one end of the bone slipping under the other—may occur.

One rib only may be broken, but often the fracture is multiple, involving many ribs, and, in the worst cases, the ribs of both sides. Rarely, from a severe direct injury, one or more ribs may be broken in two places, a considerable fragment being detached from both the vertebral and sternal end of the bone; or, the rib may break where struck, and also at a distance from this point, either near the spine or near the sternum.

When the ribs are broken inwards, the pleura is very liable to be torn, and often the lung also is wounded—more rarely the pericardium and heart.

In fracture of the lower ribs the diaphragm may be pierced and the liver, stomach, kidney, and spleen may be injured. In

sometimes found broken, and the anterior fragment of the twelfth rib may be displaced downwards to a marked degree by contraction of the quadratus lumborum muscle.

The posterior third of the bone, not far from the angle, is the



Fig. 700.—Section of a Rib at the seat of an old Fracture, showing repair with slight thickening of the bone on its inner aspect only.

compound fractures the intercostal vessels may be wounded, and occasion serious hæmorrhage; in simple fracture these vessels and the accompanying nerve nearly always escape, but a case of fatal internal hæmorrhage from wound of the intercostal artery in a simple fracture has been recorded.



Fig. 701.—Bridge of Callus uniting two fractured Ribs.

Union of a fractured rib takes place rapidly in three to four weeks, and owing to the impossibility of securing perfect immobility of the fragments, the callus is abundant, and affords the best example in man of “ensheathing callus” (Fig. 699). The callus may, however, be very slight in amount, and the site of an old fracture hardly perceptible (Fig. 700). The plastic material may develop into cartilage before it ossifies. Non-union is excessively rare, but it has been met with. Suppuration around the fragments and tubercular osteitis have followed upon a simple fracture, and in a few cases a fracture appears to have been the starting-point of a chondroma of the rib. Where two or more ribs are broken bridges of bone may form between them, and unite them immovably, or the bridges may be interrupted by joints, and allow of a certain amount of movement of the ribs (Figs. 701, 702).

Symptoms and diagnosis.—In many cases the patient feels and hears the snap of the bone at the time of the injury. In all cases the symptoms come on immediately after the injury. They vary greatly in their intensity. When one rib only is broken by indirect violence, there is, as a rule, no deformity, and great difficulty in eliciting crepitus. When many ribs are broken, there may be most marked deformity and crepitus to indicate the nature of the injury. The first rib is so concealed by the clavicle that its fracture is almost impossible to diagnose.

The most constant symptom is a fixed pain. This pain is sharp, cutting or stabbing in character, felt at the seat of fracture at each deep respiration, and especially in coughing or sneezing. On passing the finger gently along the injured rib, it is found to be very tender to pressure just at the fracture, and when firm pressure is made on the rib at a distance from the seat of pain in such a way

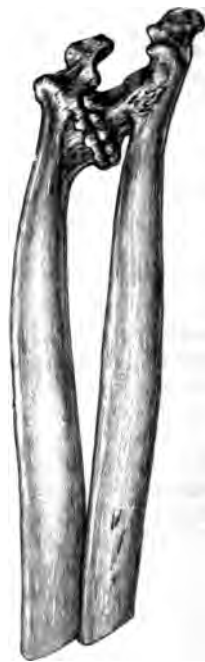


Fig. 702.—Bridge of Callus between two fractured Ribs, interrupted by a Joint.

as to bend it if sound, or move the ends if broken, a sharp pain is felt at the fracture. This fixed pain, made worse by pressure on the rib at some distance off, is a very important sign of fracture.

When a single rib is broken, there is generally no obvious *deformity* of the bone. When two or more ribs are broken, the deformity may be very marked, and at once indicate the nature of the lesion. In cases of double fracture of a rib the loose fragment may be drawn in with each inspiration, and raised again, in a most striking

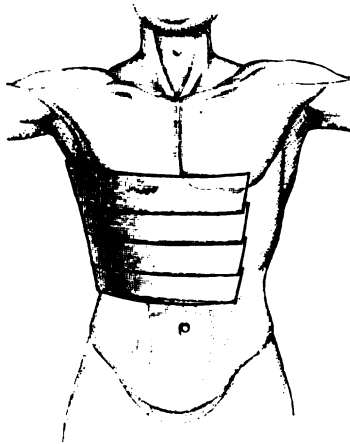


Fig. 703.—Showing Treatment of a fractured Rib by Strapping applied horizontally.

manner, with expiration. *Crepitus* is felt by the hand placed over the injured part when the patient takes a deep breath or coughs, or it may be heard by placing the end of a binaural stethoscope over the fracture.

As a result of the pain it causes, the *movement of respiration* on the injured side is greatly reduced, and when the fracture involves ribs of both sides, or occurs in patients with disease of the lungs or heart, there is great respiratory distress.

Subcutaneous *emphysema* starting from the seat of injury is a frequent and very significant phenomenon. Friction, indicating a limited dry *pleurisy* around the fracture, is often heard a few days after the injury. In cases of compound fracture the fragments are easily felt by the probe or finger, and other grave symptoms from injury of vessels, pleura, and lung generally predominate over those of the injury to the bone; in cases of severe simple fracture also the symptoms of pulmonary complications—such as *pneumothorax*, *hæmothorax*, and contusion of lung—may overshadow those of the broken rib. In cases of difficulty the diagnosis will depend upon the recognition of a sharp fixed pain in a rib, made worse by

movement in the length of a rib, such as is produced by respiratory efforts or by the surgeon's compression of the chest.

Complications.—The most important complications are injury of the pleura, lung, pericardium, heart, great vessels, diaphragm, liver, spleen, stomach, intestine, and kidney, diaphragmatic hernia, and hernia of the lung. Bronchitis, emphysema of the lungs, and valvular or degenerative disease of the heart greatly aggravate the danger of the injury.

Treatment.—In the majority of cases the best treatment consists in limiting the movements of the injured side by carefully-applied strapping. The plaster, spread on stout unbleached calico, should be cut into strips two inches wide and long enough to encircle the injured side of the chest, and extend two inches beyond the middle line both in front and behind. The strapping should be applied from below up, and extend well above and below the fracture. It may be applied horizontally or obliquely (Figs. 703, 704), or the strips may be put on alternately in the horizontal and oblique direction. Care must be taken that the patient does not hold his breath while the side is being strapped, but, on the contrary, he must be made to empty his chest as completely as he can. When strapping the side increases the pain, or embarrasses the breathing, it should not be employed, and in these cases the



Fig. 704.—Strapping applied obliquely for Fracture of a Rib.

patients should be kept in bed, lying on the back. When ribs are broken on each side, or when the patient is the subject of pulmonary emphysema, chronic bronchitis, or heart disease, or is aged, he should be kept in bed without any application to the chest, or at most with a rib-roller applied round the trunk, not too firmly. The danger in these cases is that the diminished respiratory

movements may lead to serious and even fatal engorgement of the lungs. Such patients must be propped up in bed, kept in a uniform temperature, and most carefully watched. Where the heart's action is weak, digitalis and strychnia will be useful; where there is great venous engorgement, bleeding is called for; where a frequent painful cough is the chief symptom, small doses of opium will be very beneficial. Where a fragment of bone is depressed, no compression of the chest should be attempted, and where the fracture is simple an operation should not be undertaken to raise the bone.

It must not be forgotten that a broken rib, which in a young healthy subject is a trivial accident, not entailing any confinement, is in an old subject, or in one with visceral disease, a very serious accident, necessitating the most careful management and guarded prognosis.

(c) **Dislocation of the vertebral ends of the ribs** is a very rare injury. It is always the result of great violence, which usually causes other and more serious lesions, such as fracture of the spine and contusion of the thoracic viscera. The injury has generally been only recognised after death, and its diagnosis is very difficult, if not impossible. It admits of no special treatment. If uncomplicated, it is followed by recovery.

(d) **Fractures and dislocations of costal cartilages** are much less common injuries than fractures of ribs.

Varieties.—The costal cartilages may be broken vertically at or near to their junction with the ribs; less often they are broken in their middle; more rarely still they are dislocated from the sternum, or at the joint with the costal cartilage above.

Ætiology.—Fracture of the cartilage is predisposed to by a softening of the cartilage, with a fibrillation of the matrix, the fibres taking generally a vertical direction. The force may be direct injury, as a fall or blow; indirect injury, such as a blow on the back or the outer end of the clavicle; or muscular action.

Displacement.—The line of fracture is most often vertical, possibly on account of the vertical fibrillation of the cartilage; it may be oblique, and when accompanying transverse fracture of the sternum, the fissure may extend transversely through the cartilage. As a rule, the vertebral fragment projects in front of the sternal, but the reverse may be the case. The displacement is very difficult to correct; in a case under my care I was quite unable to replace a rib cartilage riding forwards on the sternum.

Symptoms.—If there is no displacement these injuries are usually unrecognisable; in other cases displacement, pain, tenderness, and mobility indicate the injury, and the exact position of the swelling determines its nature. Fracture is most common in the seventh cartilage, dislocation in the fourth.

Mode of union.—Fractures of the costal cartilages unite by bone, which is formed from the perichondrium; within this layer of bone the ends of the cartilage are found rounded off, fibrous, and united by fibrous tissue (Fig. 705).

Treatment.—Displacement should be corrected, if possible, and the parts fixed in position by a broad piece of strapping or by a rib-roller applied around the chest.

4. Injuries of the pleura and lung.

- (a) Contusion and wound of the pleura.
- (b) Contusion of the lung.
- (c) Rupture of the lung.
- (d) Wounds of the lung.
- (e) Complications of injury of the lung : (1) from hæmorrhage ;
(2) from escape of air.
- (f) Prolapse of lung.
- (g) Foreign bodies in the pleura and lung.

(a) **Contusion and wound of the pleura.**—The pleura may be ecchymosed from *contusion*, but this cannot be recognised clinically, although it may be assumed to have occurred when a limited dry pleurisy follows a blow on the chest in cases where



Fig. 705.—Healed Fracture of a Costal Cartilage; the fragments are embedded in bone and united also directly by a narrow band of fibrous tissue.

there is no evidence of wound of the lung. A subcutaneous wound of the parietal pleura by a broken rib may be recognised by the same signs.

Wound of the costal pleura without wound of the lung is a rare injury. It may be caused by a blunt weapon pushing the soft and yielding lung before it, or by the pleural sac being opened beyond the edge of the lung. The pleura in the back extends as low as the twelfth rib, or even below it, but the lung does not reach beyond the tenth rib; and penetrating wounds in the tenth and eleventh space open the serous cavity, without injury to the lung. As the diaphragm is in contact with the chest wall below the lung, a wound here is very liable to involve this muscle and the liver, spleen, or kidney beneath it. In the front of the chest, also, the lung does not extend so far as the pleura. Bullets have been known to traverse the pleural cavity without injury to the lung, or to wound the pleura indirectly by splinters from a broken rib.

The *signs* of a wound of the pleura are, in some cases, protrusion of the lung; in other cases, pneumothorax, moderate subcutaneous emphysema, hæmothorax, or traumatopnœa without hæmoptysis; and in other cases there are no symptoms at all. The extent to which collapse of the lung occurs, with its accompanying dyspnœa, varies considerably, being influenced by the size, position, and nature of the wound. If the wound in the chest wall is an oblique track through muscle, or if there are pleuritic adhesions, no collapse of

lung ensues. When the wound is valvular, so that with inspiration air is drawn into the pleural sac, but does not escape freely with expiration, great collapse of lung occurs. When the injury or the subsequent examination separates the lung from the chest wall, collapse also occurs. When there is nothing to interfere with the natural cohesion of the parietal and visceral pleura, and no tension in the pleural cavity, collapse may be absent, or only slight in amount. When the lower part of the pleura below the lung is wounded, there may be no collapse of lung. *Pleurisy*, which often runs on to *empyema*, is very liable to supervene.

If uncomplicated, the *treatment* consists in careful antiseptic cleansing of the wound, and its closure by sutures. When possible, buried sutures of fine silk should be placed in the pleura. An antiseptic dressing should be applied externally, and the patient kept in bed, lying, if possible, on the injured side.

The *prognosis* of such cases is good, if only septic infection is avoided. The collapsed lung expands again to almost, if not quite, its former state. A wound of both pleurae, if there are no adhesions to prevent collapse of the lungs, is usually at once fatal.

(b) **Contusion of the lung without rupture of the pleura** is far from rare, and not unfrequently complicates fracture of the ribs. The effects of pulmonary contusion are two: an escape of blood into the air cells, and, in some cases, an escape of air from the air cells into the connective tissue of the lung. When slight, it gives rise to no appreciable physical signs until after a few days, when the effused blood is coughed up as a rusty or sooty sputum. When the injury is more extensive, it leads to severe spasmodic dyspnoea, cough and hæmoptysis, and examination of the chest reveals slight localised dullness with fine moist râles. In these cases, if air escapes beneath the pleura—interstitial emphysema—it passes to the root of the lung and the mediastinum, and may spread thence into the cellular tissue of the root of the neck and the back, where it produces a finely crepitating soft swelling. The position in which the subcutaneous emphysema makes its appearance distinguishes it from that caused by a wound of the lung, where it is found first over the seat of injury.

Cases of contusion of the lung should be *treated* by rest in bed, in a room kept at a uniform temperature. The patient should restrain, as far as possible, all efforts of coughing. This care should be maintained as long as the sputum continues tinged with blood, recent or altered.

(c) **Rupture of the lung** is said to have occurred when contusion of its substance is associated with laceration of the visceral pleura. It is caused by violent contusions of the chest or by strong expiratory efforts. It results in the escape of air and blood into the pleural cavity, but the absolute and relative amounts in which these effusions occur vary very much with the character and position of the rupture, and with the size of the vessels and the bronchial tubes involved. In the worst cases the lung is so torn and bruised, and

then so compressed by the blood and air in the pleural cavity, that its function is wholly interrupted. Rupture of the lung is diagnosed by the signs of pneumothorax, or hæmothorax, or of these two together, in cases where there is no penetrating wound of the chest wall. As the air which escapes into the pleural sac has been filtered of its organisms by passing through the lungs, infection of the pleura does not occur. The repair of an injury of the lung is very rapid, and also very perfect, and the lung shows great tolerance of injury. The *treatment* of this condition resolves itself into that of its two great effects—pneumothorax (page 418) and hæmothorax (page 417).

(d) **Wounds of the lung** may be caused by the sharp fragments of a broken rib, by stabs with sharp-cutting instruments, or by bullets and other blunt weapons. The effects vary considerably with the extent, position, and nature of the wound. The wound produced by a broken rib is usually slight in extent; sword thrusts may be deep, but bullet wounds are the most extensive and severe, and they are liable to be further complicated with bruising and tearing of the lung, and by the lodgment of foreign bodies, such as portions of clothing and of bone, or the bullet itself. Wounds near the root of the lung are the worst, as the main branches of the pulmonary vessels and the larger bronchial tubes are involved. Incised wounds bleed very freely, but bullet wounds are still more dangerous, although causing less hæmorrhage, because they are so liable to carry infective material into the lung.

Wound of a lung is attended by two special consequences—the escape of blood and of air from it. The *hæmorrhage* may be so profuse as to destroy life in a few moments either by acute anæmia, by asphyxia—from the blood flowing into the larger bronchial tubes—or by compression of the lungs by the blood accumulating in the pleural sacs. The blood may be coughed up (*hæmoptysis*), escape externally (*external hæmorrhage*), or accumulate in the pleura (*hæmothorax*), and the event is determined by the position, size, and direction of the external wound, as well as by the extent and position of the wound in the lung. Air may escape from the lung into the pleura, and give rise to *pneumothorax*. More commonly it passes into and out of the pleural cavity through the wound in the chest with a hissing or bubbling sound. This symptom is called *traumatopnœa*. When the external wound is oblique, air may be sucked or forced into the cellular tissue of the chest wall (*emphysema*).

Symptoms.—There may be none. As a rule, however, the symptoms are well marked. The patient experiences a sense of oppression across the chest, dyspnœa, and a tendency to cough. There is more or less shock and anæmia, and to these symptoms are added those resulting from the division of the vessels and air-tubes of the lung—*hæmoptysis*, external hæmorrhage, hæmothorax, pneumothorax, and emphysema. These symptoms vary greatly in intensity in different cases. The hæmorrhage may recur a few hours after the injury, or come on some time later (secondary hæmorrhage) from a foreign body ulcerating into an artery or vein. Following the

immediate symptoms there may develop those of *pneumonia*, *pulmonary abscess* and *gangrene*, or *empyema*.

Results.—The lung is tolerant of injury. Its collapse favours thrombosis in the divided vessels and the arrest of hæmorrhage. Incised wounds are soon sealed by blood-clot, and unless infected from without, primary union rapidly occurs, and leaves an almost imperceptible scar. A contused and lacerated wound heals more slowly, and leaves a larger scar. Apart from the effects of hæmorrhage, and of the abolition of function in the wounded lung, infection with pathogenic organisms is the great danger. Infection rarely, if ever, occurs through the air escaping from the divided bronchial tubes, for this is effectively filtered in its passage through those tubes; but the infection is conveyed in the air drawn in through the chest wound, and especially on foreign bodies carried into the pleura or lung. It is this that causes the special danger of bullet wounds.

The statistics of military surgeons show a great mortality after wounds of the lung, which are one of the chief causes of death in warfare. Simultaneous wound of both lungs—as by a bullet or sword-thrust passing through the chest from side to side, or two separate bullet wounds—is nearly always very quickly fatal, but such an injury has been recovered from.

Treatment.—This resolves itself into attention to the following five points:—(1) The arrest of hæmorrhage, (2) the prevention of infection, (3) the removal of foreign bodies, (4) the limitation of emphysema, (5) the securing of rest to the lung. The best means of arresting hæmorrhage are discussed in the following section. Infection is to be prevented by the careful use of antiseptics. The external wound and the skin around must be thoroughly cleansed in the usual way. The surgeon's finger, probe, or forceps must be rendered aseptic before introduction into the wound. The surface of a clean-cut wound should be at once united with sutures, and a large antiseptic dressing applied. In gunshot and other contused wounds, detached fragments of bone and pieces of clothing and bullets should be gently removed. No force must be applied, nor should too prolonged a search or attempt at removal be made, lest severe and fatal hæmorrhage be started. Deep wounds of the lung must not be syringed out, lest the fluid be injected into the bronchial tubes. In such cases the external wound should not be closed, and, if necessary to secure free drainage, a tube should be inserted. The patient must be kept in bed, lying on the injured side, to limit the respiratory movement, to secure a measure of rest to the lung, and to ensure proper drainage. The patient must be kept as quiet as possible, and great care be taken to avoid all causes of physical and emotional disturbance.

(e) **Complications of injuries of the lungs.**—We shall here deal with certain special phenomena or complications of injuries of the lungs, which are of sufficient importance to be separately discussed. The late complications or sequelæ are described on page 425.

(1) *External hæmorrhage* from a wound of the lung may be very

profuse. The blood generally escapes most rapidly during expiration, and is frothy from admixture with air: cough, hæmoptysis, dyspnœa, traumatopnœa, and general distress or threatened syncope also point to the injury of the lung.

The *treatment* consists first in the use of hæmostatics, such as turpentine inhalation, and a subcutaneous injection of ergotin; secondly, in limiting the movement of that side of the chest by placing the patient on his injured side, and restraining excitement, coughing, talking, or movement; thirdly, in allowing the blood to accumulate in the pleura, and compress the lung—for this the wound is closed by sutures or by a suitable dressing. The patient is encouraged to suck and swallow ice freely. The old plan of producing syncope by a rapid venesection, in the hope that with the weakened force of the heart the blood would coagulate in the wounded vessels, is now abandoned.

(2) *Hæmothorax*, or effusion of blood into the pleura, is usually caused by a wound of the lung and pulmonary pleura; but it may arise from a wound of an intercostal artery or of the internal mammary artery. It is generally associated with a penetrating wound of the chest, but there may be no external wound. The blood collects in the lowest part of the pleural sac, and gradually pushes up the lung. It speedily coagulates, and is rapidly absorbed. If air is admitted to the pleura from the outside, there is grave danger of the introduction and rapid growth of pathogenic organisms, and the blood-clot forms an admirable medium for the culture of such "germs." This infection excites pleurisy which rapidly leads on to empyema with more or less intense septic intoxication. Air gaining access through the lung is innocuous, as it is freed from organisms in its passage through the bronchial tubes.

The signs of hæmothorax are dulness over the lower part of the region previously occupied by the lung, loss of vocal fremitus and resonance in the dull area, and the breath-sound is either distant, weak, or absent. These signs come on quickly after the injury, and are associated with dyspnœa, and the general signs of loss of blood. In many cases ecchymosis of the loin is noticed a few days later, owing to the blood infiltrating the cellular tissue of the back; too much stress must not be placed on this phenomenon, as it may be due to a contusion of the loin without any intra-thoracic lesion. Hæmothorax is often combined with pneumothorax.

In the *treatment* the first indication is to stop the hæmorrhage by the use of the means already described. Should the accumulation of blood in the pleura threaten suffocation, the wound should be opened up, or if no wound exists, a free incision should be made, and the blood allowed to escape. This should only be done when sufficient time has elapsed to ensure the arrest of the bleeding, and the necessity for such a step only rarely arises. If signs of suppuration supervene—such as fever, rigors, increasing dulness and respiratory difficulty, with superficial œdema—the mixture of pus and blood should be evacuated without delay, either through the original

wound, or, if that is not well placed for drainage, by a free incision as for empyema, and the cavity should be then treated by antiseptic drainage. In such a case care should be taken to remove entirely all the blood-clots and all the infective material in the pleural sac.

(3) *Hæmoptysis* occurring from wounds of the lungs may be slight, or so profuse as to be fatal from the blood filling the bronchi. When a wound of the lung is superficial, even though extensive, there may be no hæmoptysis. Statistics show that hæmoptysis is present in the proportion of 40 out of 43 cases of wound of the lung.

The patient should be kept in the upright position, as perfectly at rest as possible, and he should suck ice. If there is great restlessness, morphia may be given; and if there is dyspnoea and cyanosis, a rapid phlebotomy may relieve these symptoms and arrest the bleeding from the lung.

(4) *Pneumothorax*, or escape of air into the pleural cavity, may be caused by an external wound opening the pleura, or by a wound or rupture of the lung and visceral pleura. When there is an external wound, air passes into the pleura with each inspiration; when there is a wound in the lung, air is passed through it with each expiration, until the resistance to its escape equals that opposed by the narrow orifice of the glottis. As the air accumulates, the lung collapses and respiration is greatly embarrassed. In favourable circumstances the air is absorbed, the oxygen being first removed and replaced by carbonic acid gas. When due to an external wound, infection of the pleural cavity leading to suppuration (*pyo-pneumothorax*) is liable to occur.

The signs of pneumothorax are dyspnoea and orthopnoea, distension of the side of the chest, and a tympanitic percussion note over the area of the pleura; over the same area the respiratory murmur is lost or amphoric, the voice sound is amphoric, bronchial râles have a metallic tinkle, and the "bell sound" is heard when one copper coin is struck against another placed on the chest. The heart is displaced to the opposite side.

When life is threatened by suffocation, the cavity of the pleura should be tapped with trochar and cannula; in a case of this kind under my care the air escaped with a hissing sound, and the lung at once expanded almost to its full extent: the patient, a boy, made a rapid and complete recovery. For pyo-pneumothorax, the pleural cavity should be drained.

(5) *Emphysema* is the name given to infiltration of air in the cellular tissue: it is sometimes called subcutaneous emphysema, to distinguish it from vesicular and interstitial emphysema of the lung. It may be produced in the following ways:—

(a) Sub-pleural rupture of the lung.—The air escaping from the air-cells passes along the interalveolar connective tissue to the root of the lung, and thence by way of the mediastinum to the root of the neck, whence it spreads over the shoulders and trunk. This is a rare accident. The place at which the air reaches the superficial cellular tissue is diagnostic of this form of emphysema.

(b) Subcutaneous wound of the lung, *e.g.* by the sharp edge of a broken rib. The air may escape into the pleural sac with each inspiration (pneumothorax), and during expiration be forced out through the wound in the parietal pleura into the cellular tissue of the side, not escaping through the lung, because under the pressure of expiration the edges of the wound on its surface are compressed together. In most cases of emphysema from simple fracture of a rib, however, there is no pneumothorax, and the air passes directly from the lung into the chest wall. One explanation of this fact is that the injury has occurred at the seat of an old pleural adhesion, which shuts it off from the general pleural cavity. Another explanation lies in the fact that the cohesion of the two surfaces of the pleura is sufficient to prevent the spontaneous collapse of the lung. During inspiration the lung expands and fills with air, but during expiration, when the air in the lung is under pressure, a little of it passes directly through the wounded surfaces of the pleura into the cellular tissue of the chest wall, but the pressure is never sufficient to separate the two surfaces of the pleura.

(c) A valvular wound of the chest wall only.—If the pleura is opened, even if the lung is not wounded, air may pass freely into the pleural sac during inspiration; but with expiration the surfaces of the wound may so come together as to prevent the free escape of this air, and it is then forced into the cellular tissue. It has occasionally happened that in the case of an irregular wound of the chest wall, without perforation of the pleura, air has been sucked in during inspiration, and with every expiration forced farther and farther into the cellular tissue, until the emphysema has even become general.

Symptoms.—The presence of the air causes a soft ill-defined swelling of the chest wall; the skin over it is not discoloured; on gentle compression it yields and a fine dry crepitation is felt, caused by the passage of air from space to space in the cellular tissue. This crackling sensation is very characteristic. Light percussion over the swelling gives a hyper-resonant or tympanitic note. The swelling is not affected by the movements of respiration. When caused by sub-pleural rupture of the lung, the swelling appears first at the root of the neck and spreads thence; when due to either a wound of the lung or of the chest wall, it is first noticed around the wound, and from thence spreads more or less widely. As a rule the emphysema is limited in extent, and the crackling swelling is felt over a few square inches or over one side of the chest only. But it may be very extensive, spread over the entire trunk, into the neck and face, and even reach to the limbs. In the worst cases it causes great embarrassment to respiration and circulation and may even be fatal. The serious cases are those in which the air infiltrates the mediastina, or where pneumothorax is associated with the emphysema.

Treatment.—When slight, nothing is required beyond the application of strapping or a bandage to the chest. This limits the infiltration of air, and the blood quickly absorbs it from the tissues.

If the emphysema is very extensive and causes inconvenience, the air must be allowed to escape through multiple punctures in the skin.

(f) **Prolapse of the lung**, or protrusion of a part of a lung through a wound in the chest wall, is a rare accident. It may occur in any case in which the pleura is opened, but is most likely to result from an extensive wound. The protrusion takes place during expiration, especially a forced expiratory effort, such as a cough. The air in the lung during expiration is under pressure, and when one part of a lung has lost the support of the chest wall, it may yield under the pressure of the contained air and be forced out of the cavity. It is stated that, during expiration, air may be expelled from the opposite lung across the bifurcation of the trachea into the injured lung, and distend it where it has lost its usual support. The prolapsed mass varies in size; it is smooth on the surface, dark in colour, crepitates when compressed, and expands with forced expiration or a cough; it may be reducible on gentle pressure. Adhesions quickly form between the two layers of the pleura at the base of the prolapse. The prolapsed lung may become congested, and ultimately gangrenous, or gradually shrink and disappear.

Treatment.—If the lung is not gangrenous, nor so seriously congested as to render the occurrence of gangrene probable, an attempt should be made to replace it within the pleural cavity, and to close the external wound over it. To effect the reduction it may be necessary to divide the tissues around the base of the prolapse. If reduction is impossible, or if the lung is too seriously congested to render it safe to return it, it may be left to nature to detach the sphacelus, or the surgeon may anticipate nature by removing the prolapsed lung after transfixing its base with a stout double ligature, and tying it very firmly.

(g) **Foreign bodies in the pleura and lung.**—Bullets of various kinds and portions of dress are the foreign bodies most often introduced into the thorax. Cherry stones, toy darts, heads of grasses, etc., have been inhaled into the lungs through the bronchi, but these cases are dealt with on page 390, and here we have to discuss only those cases where the foreign body gains entrance through the chest wall.

Bullets in the pleura fall to the bottom of the serous sac unless prevented by old adhesions; here they may become shut off—encysted—but often the pleura becomes infected, and supuration ensues. The bullet is not the source of infection, and its removal does not dissipate the danger. Great care should be taken to disinfect the external wound, and no effort should be made to find or remove the bullet. If *empyema* follows, a free incision should be made in such a position that the lowest part of the pleural sac can be explored, and the pus and the foreign body evacuated.

Foreign bodies in the lung, if aseptic, may become encysted

and remain innocuous. They often carry in with them infective organisms; if these set up a localised suppuration, the abscess may discharge through the bronchi, or by the external wound, and heal up, after the expulsion of the foreign body by coughing. But owing to greater intensity of the infective matter they may set up a rapidly spreading and fatal pneumonia. Foreign bodies in the lung may also lead to fatal hæmorrhage, either primary or secondary.

The *treatment* of these cases is beset with difficulty; it may be impossible to find the track of the wound, especially if the external wound is small, the lung collapsed, and the respiration embarrassed; it may be impossible to distinguish the foreign body from the firm wall of a bronchial tube, and it may be impossible to detach it without doing further serious injury to the lung and inducing profuse hæmorrhage. The wise course appears, therefore, to be to explore the wound carefully with the finger or probe if the track is distinct, and then if the foreign body is plainly felt, a very careful and gentle effort should be made to remove it. Should severe hæmorrhage follow upon this effort, the wound in the lung should be plugged with aseptic gauze. In other cases the surgeon should leave the foreign body alone and wait. If the patient survives, and suppuration occurs, and the foreign body is not spontaneously expelled, another more thorough and more prolonged attempt to remove it should be made.

5. Injuries of the pericardium, heart, and great vessels.

(a) Injuries of the pericardium only.

(b) Injuries of the heart and great vessels.

(a) **Injuries of the pericardium.**—The pericardium may be bruised or torn by severe contusion of the chest, without any external wound. It may also be pierced by the end of a broken rib or sternum, by cuts, stabs, needle punctures, and bullets, and by needles or other sharp bodies escaping from the œsophagus. Injury of the pericardium without wound of the heart is rare, but it does occur even in the case of gunshot wound. It is the lower two-thirds of the pericardium which is most often injured, and as only a small part of the front of the pericardium is uncovered by pleura, it follows that most of the cases of injury of the pericardium from the front are also complicated by wound of the pleura and lung. (See Fig. 723.)

Symptoms.—Subcutaneous injury of the pericardium only cannot be diagnosed. It is attended with marked shock and cardiac failure, and, subsequently, the symptoms and physical signs of pericarditis come on. But this is the same clinical picture as is afforded by contusions and injuries of the heart. Wounds of the pericardium are recognised by the position and direction of a wound in the chest wall, by the signs of cardiac failure, and in some cases by the escape of pericardial fluid, and the exposure of the heart in the wound. Pericarditis with effusion, which is generally purulent, is very liable to follow, and to occasion dyspnoea and orthopnoea, a frequent feeble

pulse, with a tendency to syncope and coldness of the extremities, increase of the area of cardiac dulness, raising of the heart's impulse, and friction with muffling of the heart's sounds. These physical signs may be obscured by the association of pleurisy with effusion.

The *prognosis* is always grave, but of fifty-one cases of wound of the pericardium only, twenty-two recovered. The chief danger is septic infection of the wound. Most of the cases of wound of the pericardium are complicated by more serious and fatal injuries.

The *treatment* consists in the prevention of infection of the wound, and in securing complete rest to the patient. If pericarditis with effusion ensues, and causes serious pressure on the heart, the sac must be tapped or drained, according to the nature of the fluid. (See page 446.)

(b) **Injuries of the heart and great vessels.** 1. *Rupture of the heart.*—The muscular substance of the heart may be bruised or lacerated by severe contusion of the chest, with or without fracture of the sternum or ribs. The rupture may occur at any part of the heart, but is most frequent in the left ventricle and right auricle. It may be met with in healthy muscular tissue, but is more readily produced if the muscle has undergone fatty or fibrous degeneration. "Spontaneous rupture" of the heart is met with in cases of disease, especially in tetanus and delirium tremens, as well as under profound emotion.

2. *Wounds of the heart* are most often inflicted from the front of the chest by stabs, punctures, gunshots, and the end of a broken rib or sternum, but needles and fish bones may penetrate it from the œsophagus. In the case of a "spent" ball striking the chest, the heart may be bruised or torn without any perforation of the pericardium. Wounds of the heart vary in their position, depth, and extent. They may involve the muscular substance of a ventricle without perforation of its cavity (non-penetrating), or they may open one of the cavities of the heart (penetrating), or pass quite through the heart, or even separate it entirely from all the vessels at its base. Of a series of 351 cases of wounds of the heart, only thirty-eight were non-penetrating. Owing to the position of the heart in the chest, the right ventricle is more often wounded than the left; the position of the wound depends also to some extent upon whether the heart is in systole or diastole at the moment of injury. Fischer's statistics show one hundred and seventeen cases of wound of the right ventricle, eighty-nine of the left ventricle, sixteen of the right auricle, and six of the left auricle.

As hemorrhage is the most important consequence of wound of the heart, much depends upon the extent, direction, and situation of the wound. Longitudinal wounds gape much less than transverse, and are, therefore, less serious. The wall of the auricle is so thin that when wounded it offers no resistance to the flow of blood, and death ensues rapidly. The blood may accumulate in the pericardium, and by pressure interfere with the heart's action. When the external wound is extensive the blood escapes externally,

and also passes into the pleura and mediastinum. Foreign bodies—such as bullets, pieces of wood, and pins or needles—have been known to lodge in the muscular substance, particularly of the apex, or even in a cavity of the heart, and remain for weeks or even years; indeed, a man has lived for twenty days with a skewer transfixing his heart from side to side. But these cases are generally at once fatal from “shock,” or only survive a short time.

If the patient does not die from the immediate effects of the injury, pericarditis, myocarditis, and endocarditis are very liable to supervene, and prove fatal, either quickly or more tardily, after leading to dilatation of the heart or sclerosis of the valves.

3. *Injuries of the valves.*—As a result of a contusion of the chest, or severe cardiac strain, a valve may be ruptured, or one or more of the chordæ tendinæ may be torn. About 25 per cent. of ruptures of valves are traumatic in origin. The aortic and mitral valves are most often torn, the tricuspid rarely, and the pulmonary valves never. The endocardium may be ruptured without laceration of the muscle of the heart.

4. *Injuries of the great vessels.*—Either of the great vessels may be wounded by a stab or gunshot, and the aorta may be pierced by a foreign body passing into it from the œsophagus. The great vessels may also be torn across by a severe contusion of the chest.

Symptoms and terminations.—Contusion and slight non-penetrating wounds of the heart can only be inferred from such symptoms as weak and frequent action of the heart, a sense of oppression at the præcordia, and syncope. *Rupture of the heart* is quickly fatal from hæmorrhage or total arrest of the circulation. The symptoms of *wound of the heart* are very various. When a person is shot or stabbed in the heart, he often utters a scream, and suddenly starts up and falls dead, but there may be neither scream nor start. When not immediately fatal, there is great shock, pallor, a very weak irregular pulse, great distress, restlessness, and dyspnoea. The heart-sounds are replaced or obscured by churning noises. The external hæmorrhage may be very abundant. Later, if the patient survives, signs of pericarditis are observed, and the heart's action continues rapid, turbulent, and weak, while later still, degenerative changes set in. *Rupture of a valve* usually occasions a loud bruit, more or less serious disturbance of the circulation, and the valvular incompetence is sooner or later fatal. The valve affected can be recognised by the character of the bruit—its time, site, and direction of conduction—and the abrupt development of the bruit determines its traumatic origin. *Wounds or rupture of the great vessels* are quickly fatal from hæmorrhage, but a case is recorded of a man who lived for a year after receiving a stab wound involving the first part of the arch of the aorta. The fatal result may be delayed by incomplete division of the vessel—the undivided coats subsequently giving way—or by plugging of the wound by a splinter of bone or other foreign body. *Wound of the coronary artery* is a very fatal injury. The causes of death after these injuries are, primarily, hæmorrhage, paralysis of the

heart, and compression of the heart by blood in the pericardium; secondarily, cardiac failure and valvular incompetence.

Treatment.—The great majority of cases do not admit of any treatment. All that can be done is to keep the patient at perfect rest in the horizontal position, and to render the wound aseptic, and dress it with a suitable antiseptic dressing. It must be borne in mind that a feeble heart-action favours the closure of a wound by blood-clot, and great care must be taken not to dislodge such a clot by stimulating the heart, or by probing the wound. Sleep should be secured by narcotics. Suture of wounds of the heart has been proposed.

Hæmopericardium is the name given to an accumulation of blood in the pericardium. The blood may come from a wound of the heart or of a great vessel, of the coronary artery, or of the internal mammary artery. It occasions great embarrassment of the circulation by compressing first the auricles—so as to arrest the flow of blood towards the heart—and then the ventricles, until the heart's action stops. There is increased cardiac dullness, loss of the cardiac impulse, and enfeeblement of the heart's sounds. If caused by bleeding from the internal mammary artery, that vessel should be tied, and then the pericardium should be emptied of blood, and the wound in its sac carefully closed. When due to a wound of the heart, operation affords only the slenderest, if indeed any, prospect of good. The rupture of an aneurysm into the pericardium is another cause of sudden and great effusion of blood into the serous sac. This form is always at once fatal.

6. Injuries of the œsophagus, thoracic duct, and mediastinum.

(a) **Wounds of the œsophagus in the thorax** from external injury are very rare, and are usually complicated with other serious injuries. The gullet may be wounded from within by sharp or pointed foreign bodies swallowed, or in the attempts to remove them; it may also be ruptured by violent vomiting. Where there is an external wound, the injury is recognised by the escape of food and drink from the wound, and the patient suffers from dysphagia and thirst. Where there is no external wound the symptoms are very obscure, being mainly those of suppuration and pyæmia.

The only *treatment* that can be practised is, if possible, to feed the patient per rectum until the wound in the gullet is healed. The external wound should not be closed, but care should be taken that any matter escaping from the œsophagus shall have a very ready exit from the body. If a tube can be passed into the stomach, food can be introduced through it. (See also page 549.)

(b) **Wounds of the thoracic duct** are recognised by the continuous escape of lymph from the wound; the fluid becomes milky during digestion. Unless fatal from other injuries, death results from inanition. The lymph may collect in the pleural sac, and give rise to serious compression of the lung and heart. The duct may be wounded in the operation of ligature of the left subclavian artery,

and in opening abscesses in the posterior mediastinum. It may be ruptured from contusion without injury of either pleura, and has been known to burst during an attack of whooping cough. In these cases the milky fluid collects in the pleura, giving rise to chylous hydrothorax. (See also p. 662, Vol. I.)

(c) **Injury of the mediastinum.**—Contusion of the mediastinum and effusion of blood into the cellular tissue—*hæmomediastinum*—is a rare condition, resulting from contusions, fracture of the sternum, and wounds of the internal mammary artery or of the heart. It is liable to be followed by suppuration, and great care should be taken to prevent this by thorough asepsis.

7. Sequelæ or secondary complications of injuries of the chest.

- (a) Sub-pectoral abscess.
- (b) Peripleuritic abscess.
- (c) Pleurisy and empyema.
- (d) Pneumonia, pulmonary abscess, and gangrene.
- (e) Pericarditis, myocarditis, and endocarditis.
- (f) Mediastinal abscess.
- (g) Pneumocèle or hernia of lung.

The secondary complications of injuries of the thorax are nearly all of them the result of infection of the wound with pathogenic organisms, and every effort should be made to prevent this when the case first comes under treatment.

(a) **Sub-pectoral abscess.**—As a result of contusion of the front of the chest, with or without obvious laceration of the pectoral muscles, inflammation may occur between and beneath these muscles and run on to suppuration. The inflammation occasions a painful swelling of the part with superficial œdema, and any attempt to raise the arm forwards causes severe pain. Owing to the deep position of the pus, fluctuation may not be detected, and if untreated the abscess attains a great size before it reaches the surface and bursts. It may point through the pectoralis major muscle, or at its lower border in the axilla.

Treatment.—The pus should be evacuated early through a free incision. When possible, the opening should be made in the axilla at least a finger's breadth behind the anterior fold, so as to avoid injury of the long thoracic vessels. When the abscess is placed too near the sternum or clavicle to be reached from the axilla, the incision must be made directly over it. In either case Hilton's method should be adopted; an incision one inch and a half long should be made through the skin and superficial fascia, and then a director should be carefully pushed through the deeper tissues into the abscess, and when pus appears in the groove dressing forceps should be passed in and opened widely to expand the deeper parts of the wound. If the abscess is opened through the pectoral muscle, the incision should be made parallel to its fibres, and care be taken to separate—not to divide—the muscular bundles. The abscess cavity should be carefully cleansed of all pus by thorough

irrigation with a warm antiseptic solution, and drained by means of a large tube. The arm must be kept at rest until healing is complete; a certain amount of stiffness at the shoulder will persist for a time.

(b) **Peripleuritic abscess** is a very rare sequel of contusions and punctured wounds of the chest; it may also arise spontaneously. The inflammation starts in the sub-pleural fascia, and the pus accumulates between the pleura and the ribs; after extending for a variable distance in this fascia it usually points externally through one of the intercostal spaces, but it may open into the pleura, pericardium, or mediastinum, setting up suppuration in these tissues. It is nearly always associated with necrosis of the inner surface of a rib or rib-cartilage. The pus is stated to be of unusually high specific gravity, even so great as 1040. Much care is necessary to distinguish this affection from empyema, which it resembles by causing dulness to percussion, loss of vocal vibration and diminished breath-sounds over the dull area. The diagnosis is usually made by noticing that the swelling of the part is localised, and that the ribs are separated over it, and a little approximated above and below. The breath-sounds, although weak, retain their vesicular character, and during inspiration the affected intercostal spaces become less tense, and with expiration more tense and bulging. There is no displacement of viscera, and there may be pulmonary resonance below and all around the dull area, unlike an empyema, while the movements of respiration are not so gravely interfered with as in that disease. There is usually more local pain than in empyema. Fluctuation may be detected in one or more of the intercostal spaces.

Treatment.—Without delay the abscess should be opened. An incision two inches long should be made over the centre of the most prominent space, and carried carefully down through the intercostal muscles, immediately beneath which the pus will be found. After evacuating the pus, the ribs in the abscess wall should be carefully explored for necrosis, and if bare bone is found, that portion of the rib should be excised.

(c) **Pleurisy and empyema.**—Subcutaneous wound of the pleura, as by the sharp edge of a broken rib, is often followed by dry pleurisy extending over a limited area of the serous membrane. Adhesions may form between the two surfaces of the pleura, and to a certain extent close the serous sac. The signs of this traumatic pleurisy are local pain of a sharp stabbing character during the movements of respiration, and dry friction heard over a limited area, and sometimes felt as friction fremitus. This is not a serious complication of a fractured rib, and the fixation of the part indicated by the fracture will also relieve the pain of the pleurisy and favour resolution or the organisation of adhesions.

When, however, air is admitted to the pleura through a wound in the chest wall, and especially when a blood-clot or a foreign body is lodged in the serous sac, the pyogenic organisms carried in may set

up acute inflammation, quickly resulting in suppuration—*empyema*. The fluid secreted is at first serous, but turbid and flaky, and quickly becomes purulent. The infective inflammation generally extends over the whole, or nearly the whole of the serous membrane. It is attended with high fever, and the formation of pus may be marked by one or more rigors, and by profuse sweating. The local signs are dulness on percussion, which rapidly increases in extent from the base of the chest upwards, loss of vocal fremitus over the dull area, and on auscultation the breath-sound is absent, or distant and weak, and is bronchial or tubular in character. If the wound is closed externally, the side is enlarged, and the skin over it may be œdematous; the mediastinum is displaced towards the opposite side, and the diaphragm is depressed and pushes down the liver, or the stomach and spleen. If the wound remains open, there is no distension of the side, or displacement of parts, but there is a free, and often a very profuse, discharge of sero-pus or pus. When untreated, recovery has followed the bursting of the empyema externally, or into a bronchus, or the bowel.

Treatment.—This acute purulent inflammation calls for active surgical interference. If there is a wound it should be enlarged if necessary, and all the pus and blood-clot, or foreign body, if present, carefully removed; the cavity should then be thoroughly cleansed with a warm non-poisonous antiseptic solution, such as boric acid solution gr. x to ʒj, creolin and water, 1 per cent. Condy's fluid and water, or water containing ʒj of tincture of iodine in the pint. Free drainage of the cavity should then be secured, and a large antiseptic dressing applied. If the wound is in such a situation that it does not afford a proper aperture for drainage or for cleansing the cavity, an opening should be made below the angle of the scapula. (See page 436.)

(d) *Pneumonia.*—All bruises and wounds of the lung are followed by a certain amount of traumatic pneumonia, which, as a rule, is limited to the injured area and cannot be recognised unless extensive. Traumatic pneumonia is distinguished from idiopathic lobar pneumonia by the limited area of the lung involved, and also by its occurrence at any part of the lung without distinction. When the lung is wounded by a weapon which pierces the chest wall, and especially when a foreign body, such as a piece of clothing, is carried into the lung, the blood-clot that seals the wound and plugs the alveoli is very liable to be infected, and the growth of the infective organisms excites a more or less intense inflammation, with a tendency to spread and to run on to suppuration. Even in these cases the inflammation may be limited in area and may, after a time, subside and allow the wound to cicatrise.

When suppuration occurs it may form a circumscribed abscess and discharge through a bronchus or into the pleura, or the pus may burrow through the chest wall and discharge externally. When a foreign body is lodged in the lung the inflammation sometimes results in *gangrene*.

The *symptoms* may be entirely masked by other effects of the injury, for bruising or wound of the lung leads to rusty expectoration, and the existence of pneumothorax or pleurisy may obscure the physical signs of pneumonia. When the inflammation is septic, the general disturbance is severe, with high fever, rapid pulse, dyspnoea, and prostration, and the danger to life is very great. An abscess of the lung may declare itself by the sudden discharge of pus externally or by the mouth or rectum, and the usual signs of a moist cavity may then be detected. Gangrene of the lung will be recognised by the intensely foul odour of the breath.

Treatment.—Many of the cases do not admit of surgical treatment, and all that can be done is to endeavour to maintain the patient's strength in the hope that the inflammation may be limited in extent and resolve or form a circumscribed abscess. If an abscess declares itself and its position can be determined, an attempt should be made to open and drain it externally, and its cavity should be most carefully explored for a foreign body, which should, of course, be removed. A localised gangrene of the lung should be submitted to the same treatment, the slough being removed through the external incision as soon as it is loose (page 444).

(e) **Pericarditis, myocarditis, and endocarditis** may follow injuries of the pericardium and heart. They are usually fatal. Pericardial effusion when causing injurious pressure on the heart should be relieved by aspiration, and if the secretion is purulent, the pericardium should be opened and drained (page 446).

(f) **Mediastinal abscess** or suppuration in the anterior mediastinum is a rare affection. It occurs most often as a sequel to contusions of the chest or wounds penetrating the sternum, especially if there is lodgment of a foreign body. It also results from tubercular disease of the retro-sternal glands, disease of the sternum, septicæmia, ulceration of the œsophagus and suppuration beneath the deep cervical fascia, and has been met with after tracheotomy and thyrectomy. The pus may compress the phrenic nerves and cause paralysis of the diaphragm. The abscess may point at the side of the sternum, or the pus may pass through a sternal foramen and point in front of the sternum, but it may burst into the pericardium, pleura, œsophagus, or heart.

The *symptoms* of this disease are severe local pain and tenderness, dyspnoea, and fever. Fulness may be noticed on one side of the sternum or a distinct pointing swelling over or by the side of the sternum. There may be an increased area of dulness over the sternum, and friction, either pericardial or pleuritic, may be heard.

The prognosis is bad.

The *treatment* must be prompt and thorough. As soon as a diagnosis is arrived at, the sternum should be exposed by a sufficient incision, and a circle of bone removed with a trephine. Through this aperture the abscess cavity can be explored, and sufficient of the sternum should be removed to secure perfect drainage of the part; diseased bone, foreign bodies, granulation masses, and diseased

glands should be removed, care being taken not to injure the pericardium or either of the pleuræ.

(g) **Pneumocele or hernia of the lung** is sometimes called "secondary" or "consecutive" to distinguish it from prolapse of the lung through a wound into the pleura. (See page 420.) It is a protrusion of part of the lung through a portion of the chest wall which has become unable to resist the intra-thoracic pressure of expiration. This weakening may be from the presence of a yielding cicatrix, from a severe contusion with fracture of the ribs, or from a gradual giving way of the intercostal muscles, under the strain of frequent severe cough. Its occurrence has been stated to be favoured also by adhesion of the lung to the parietal pleura. The protrusion may occur suddenly, but more generally slowly. It forms a tumour covered by healthy skin, soft, compressible, crepitant under the hand, resonant to percussion, shrinking with each inspiration, and expanding, with a distinct impulse, on coughing or violent expiration. On listening over it a loud vesicular respiratory murmur is heard. The tumour is more or less reducible. It must be distinguished from a "pointing" empyema. Pneumocele has been met with most often in the front of the chest, over the fourth or fifth interspace. The only treatment required is external support by a well-fitting pad. (See also page 365.)

THE SURGERY OF DISEASES OF THE CHEST.

1. THE SURGICAL TREATMENT OF PLEURITIC EFFUSIONS.
2. THE SURGICAL TREATMENT OF DISEASES OF THE LUNG.
3. THE SURGICAL TREATMENT OF PERICARDIAL EFFUSIONS.
4. SURGICAL DISEASES OF CHEST WALLS.

1. **The surgical treatment of pleuritic effusions.**—The many questions arising in connection with the ætiology, pathology, and diagnosis of pleural effusion are not within the scope of a surgical handbook, and we are only concerned here with the surgical treatment of this condition. The operations at present performed are four in number: exploration of the pleura, tapping the pleura, draining the pleura, and thoracoplasty: each requires separate consideration.

(a) **Exploration of the pleura** is called for to prove the presence of fluid in the pleural sac, and to demonstrate its nature. It is as valuable as it is simple and safe, and ought to be resorted to much more often than it is. It is well known that even very large effusions may be overlooked, still more may this happen in the cases of limited effusion, and of effusion in children. It is exceedingly important to recognise the onset of effusion, especially when purulent, as the ultimate prognosis chiefly depends upon the length of time during which the lung has been

compressed and upon the density of the pleura binding it down. It is for these reasons that careful exploration should be resorted to in every case in which there is room for doubt. An ordinary hypodermic syringe may be used, but the needle of this is at times too short and often is too slender. I have known the needle to be broken off beneath the skin owing to a sudden movement on the part of the patient. It is better to use a syringe with a longer and rather stouter needle and a larger barrel. The syringe

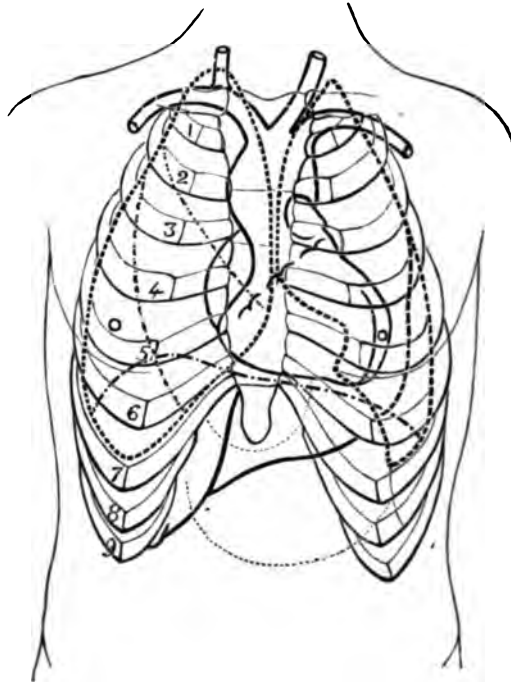


Fig. 706.—Diagram showing the Relations of the Heart, Lungs, Diaphragm, and Liver to the Chest Walls.

should be rendered aseptic by soaking in carbolic solution 5 per cent., and the skin of the chest should be cleansed in the same manner; the needle should be sterilised by passing it through the flame of a spirit-lamp. A spot for the puncture having been selected, the skin should be drawn well up and the needle thrust over the upper border of the lower rib bounding the intercostal space chosen, and passed into the pleura with a rather smart thrust, so as to traverse the tissues and not push them before it. By raising the piston, fluid if present will be drawn into the barrel. When the syringe is withdrawn, the skin slipping down makes the

puncture oblique; it should be at once covered with a collodion dressing. Such an exploration may be made anywhere within the area of the pleura. It is attended with very trifling pain, and a general anæsthetic should not be administered. For children and nervous adults the skin may be frozen by the ether spray or by ice and salt.

(b) **Tapping the pleura** is resorted to for the relief of hydrothorax and serous pleurisy, and sometimes for hæmothorax and empyema. Empyema, as a rule, requires the pleura to be drained, but simple tapping occasionally succeeds in curing it, particularly in children, and is useful as a preliminary to draining and in cases of great urgency. In tapping the pleura the surgeon should aim at evacuating the fluid without admitting air to the sac, and without inflicting injury upon important structures.

The instrument to be used.—A simple trochar and cannula will evacuate the fluid, but it offers no security against the access of air during an inspiratory effort. This objection to its use may be met in one of three ways. The cannula may be passed through the centre of a piece of linen soaked in carbolic acid solution (5 per cent.), so that on withdrawing the trochar the linen falls over the mouth of the cannula. It then offers no impediment to the escape of fluid from the chest, but it at once blocks the cannula if, during an inspiration, air is drawn towards the pleura. Another plan is to have a stopcock on the cannula, and to close it immediately the trochar is withdrawn. One end of a rubber tube is then fastened on to the end of the cannula, and the other end is dropped into a vessel containing carbolic solution (5 per cent.). On then opening the stopcock, the pleuritic fluid flows into this vessel, but no air can be sucked into the chest. A third and simple method is to have a cannula with a cross-piece, to which the rubber tubing is attached, and the trochar so made that it can be withdrawn beyond the orifice of this cross-piece, but no farther (Fig. 707). This is known as a "syphon trochar." Southey's fine trochar and cannula can also be used, with the end of the tubing in a vessel of carbolic solution. The best instrument, however, is an aspirator. Of these there are many forms. The simplest is the "bottle aspirator," in which a vacuum is made in a bottle, and then connected with the pleura (Fig. 708). Some prefer direct aspiration by means of a properly made syringe, and the combination of this with a syphon—the "syphon aspirator"—is an exceedingly good instrument. Either a hollow needle or a trochar and cannula may be used, and there are special advantages in each (Fig. 709). The merit of the needle is that if, as soon as the opening into its barrel is passed under the skin, it is connected with the vacuum of the aspirator, and the instrument is then slowly and steadily pushed on, as soon as the fluid is reached it appears in the bottle or barrel of the aspirator, and there is no danger of thrusting the needle too far. The drawbacks of the needle are its liability to be plugged by a little mass of skin or other tissue which it cuts out, instead of piercing, and its sharp point within the

pleura may scratch the expanding lung and cause hæmorrhage. Fatal hæmorrhage has occurred from this accident, but it is little likely to happen, however, if the instrument is used as described above. The advantages of the trochar and cannula are that the

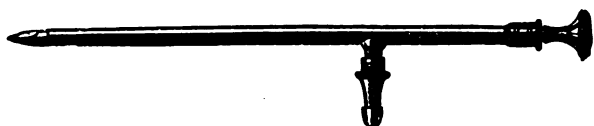


Fig. 707.—Syphon Trochar.

blunt end of the instrument can do no harm, and the cannula cannot be blocked with a plug of skin. The only drawback is that there is no means of knowing exactly how far it should be introduced in order to reach the fluid. On the whole, the trochar



Fig. 708.—Bottle Aspirator with Set of Needles.

is the better instrument to employ if reasonable care is taken in its introduction (Fig. 710).

Place of puncture.—In the case of a large pleuritic effusion the most convenient spot is the sixth intercostal space in the mid-axillary line. A space higher or lower may be taken, and the puncture may be made farther back, if preferred. In a limited effusion the cavity must be tapped over the centre of the fluid accumulation. In such cases the preliminary exploration with a fine needle should always be practised; indeed, this is desirable in all cases of pleuritic effusion submitted to operation.

Mode of procedure.—The skin around the proposed puncture and the hands of the surgeon are to be carefully rendered aseptic, and all the parts of the aspirator and other instruments used well soaked in carbolic solution (5 per cent.), the needle or trochar and cannula should be also heated in a spirit flame. The upper border of the lower rib bounding the space chosen to be punctured is felt for

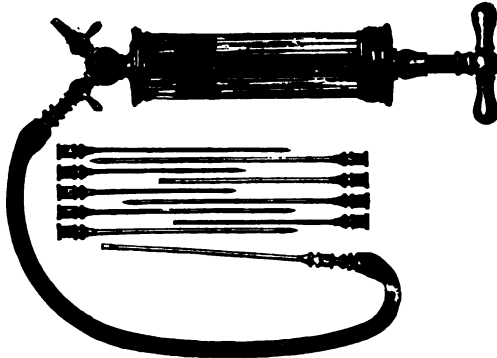


Fig. 709.—Syphon Aspirator with Set of Trochars and Cannulae.

and the skin is drawn well up over it, and carefully fixed with the left forefinger. A small puncture through the skin is made with a narrow knife, and the trochar (or needle) is then thrust into the pleura, its point being directed inwards, with a slight inclination upwards and backwards. If the puncture is made unusually low, the point must be directed well up, and in operating in the usual place, as the fluid escapes and the diaphragm rises, the cannula should be kept pointing



Fig. 710.—Best form of Trochar and Cannula for use with the Aspirator; the trochar is withdrawn beyond the stopcock, and this is then closed. The fluid escapes through the lateral tube.

upwards. The trochar should be thrust into the chest a little smartly, so as to transfix the pleura and any lymph lining it. If gently and slowly pushed forwards, it may displace in front of it the pleura or some firm lymph, and so fail to reach the fluid.

The fluid should be drawn off slowly, especially towards the end, remembering that the removal of the fluid may expose the inner surface of the lung to a pressure up to 15 lbs. to the square inch. Spasmodic cough is an indication for stopping the flow for a time, and if the fluid becomes mixed with blood, the instrument should

be at once removed. As the needle or cannula is withdrawn a pad of boric lint should be placed over the puncture and fixed by strapping, or a light collodion dressing may be used. The slipping down of the skin converts the puncture into a very oblique wound through the chest wall. Blocking of the evacuating tube is one of the accidents that may interfere with the operation. It causes an abrupt cessation of the flow of fluid, which differs from the gradual slowing of the stream as the cavity empties. The obstruction may be removed by reversing the current for a moment, or by passing a suitable stylet along the cannula or needle.

A general anæsthetic should not be given for this operation. If the patient is a child, or a very nervous adult, the skin may be rendered insensitive by the ether spray or by ice and salt. Cocaine should not be injected because of its depressing effect upon the heart, which in these cases is already embarrassed.

(c) **Draining the pleura—the operation for empyema.**—This is a more serious operation, and one that usually requires the administration of a general anæsthetic. Chloroform—not ether—should be employed, and its administration should be suspended as soon as the chest is opened. In all cases of extensive effusion, and where the respiration and circulation are much embarrassed, it is better to remove some of the pus by aspiration a few hours before the operation. This lessens the shock of the operation and the strain upon the lung caused by the sudden relief of pressure on its outer surface, and it also lessens the engorgement of the right side of the heart, and places it in a better position to withstand the effects of shock. It is well to remember that in cases of emergency aspiration, and not drainage, is the proper procedure. The details of the operation require careful consideration, especially as regarding some of them there is difference of opinion among surgeons.

Position of the opening.—The opening should not be made in the lowest part of the normal pleural cavity. This part is usually obliterated at an early stage of the inflammation, and, if not, when the fluid is evacuated the diaphragm at once rises, and the pleura covering it adheres to the lower part of the parietal pleura. The surgeon should place the drain in that part of the cavity which closes last, and that is usually the widest part of the pleura, at the level of the fifth and sixth ribs anteriorly. A favourite position for the opening has therefore been the fifth or sixth space in the mid-axillary line. The ease with which the operation is performed here while the patient lies flat on his back in bed, is a distinct advantage. Marshall suggested a spot immediately below and outside the junction of the fifth rib with its cartilage, but there are no clinical facts to warrant the preference for this spot. Others prefer the opening to be placed opposite the eighth or ninth rib immediately below the angle of the scapula. This—the posterior operation—has the great advantage of draining the pleural cavity in the most complete manner while the patient is either in the upright posture or lying on his back. As a rule, therefore, it is to be preferred; the fact

that it involves the division of a thicker layer of muscle than does the incision in the axilla is of small moment compared with the advantage it offers in the matter of drainage. The important objection to the posterior operation is that for its convenient performance the patient has to be turned over on to his sound side. In the majority of cases, and particularly where the precaution of removing some of the fluid by a preliminary aspiration has been taken, this is not of much consequence. But where the effusion is very great and the intra-thoracic pressure is high, the respiration much embarrassed and the right side of the heart engorged, to place the patient on his sound side embarrasses his breathing still more and adds to the

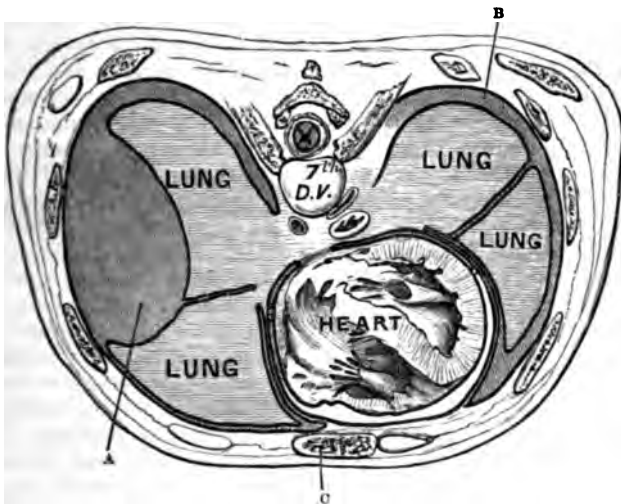


Fig. 711.—Transverse Section of the Chest, showing a limited Empyema on the right side, A, effusion in left pleural cavity; C, sternum.

danger of the operation. There are two ways of obviating this difficulty: one is to place the patient on his back with the side to be operated upon drawn well beyond the edge of a high operating-table, and operate from below. The other plan is to turn the patient well over on to his diseased side and operate from behind: of the two this is the more convenient plan, and it places the sound lung in the most favourable condition. In all critical cases of empyema, then, the pleura should either be opened in the axilla, or if the posterior operation is chosen, it should be performed from behind, but great care should be taken not to turn the patient over on to his sound side. In the case of children, it is easy to have them held over on the sound side by the hips and shoulders without any pressure upon the chest such as will interfere with the sound lung. In loculated or limited empyema the opening should be made a little below the centre of the dull area.

Excision of rib.—The pleura may be opened either through

an intercostal space, or by removing a portion of a rib. The operation of making an opening through the intercostal space is a little simpler and quicker than the other, but the sinus is apt to become seriously narrowed by the falling together of the ribs which follows the operation. An ordinary rubber drainage-tube may be closed and rendered useless by the approximation of the ribs. If a rigid tube is placed between the ribs to obviate this difficulty, its pressure may cause necrosis of a portion of rib, and if it prevents the falling together of the ribs, it in so far interferes with the natural process of recovery of the patient. If this method is adopted, the incision should be a very free one—three to four inches; such an operation is widely practised, and with success. When a portion of a rib is excised to obtain entrance to the pleura, the falling together of the ribs does not affect the drainage, nor is the retraction of the chest affected by the presence of the tube. Excision of the rib takes a little longer, and may be followed by limited necrosis if the section is not properly made, but it does not in any other way add to the severity of the operation. I prefer this operation to the older method, and it is to it that the following detailed description refers. New bone is quickly formed from the preserved periosteum, and often forms a bridge, uniting the severed rib with those on each side of it. The rib is excised simply to secure adequate and uninterrupted drainage of the pleural sac, and for no other purpose. The portion removed should only be a length sufficient to accomplish this end. The rib is not removed to facilitate closure of the sac. This operation must be clearly distinguished from the much more grave one of thoracoplasty (page 442). In thoracoplasty, on the other hand, bone is removed to enable the chest wall to retract. It is necessary to give this caution, as the excision of the rib is often spoken of as if it were the essential feature of the operation, or as if it added to the gravity of the operation, or were indicated only in the more severe cases of empyema.

The operation should be conducted with full antiseptic precautions; the carbolic spray is not requisite. The patient being turned over as little as possible on to the sound side, or far over on to the diseased side, so as to get at the back, an incision two inches long is made along the middle of the selected rib, and carried steadily and rapidly down until the periosteum is divided. With a raspatory the periosteum is separated from the outer surface of the bone, the scalpel is then drawn carefully along each border of the exposed bone to divide the external intercostal muscles, and then with a well-curved raspatory (Fig. 712) the internal intercostal muscle and the periosteum are separated from the inner surface of the rib, care being taken to keep close to the bone in the subcostal groove, and not to injure the intercostal vessels and nerve. With a special rib forceps (Fig. 713) the bared portion of the bone is divided at each end and lifted out, or the rib may be deeply grooved with a Hey's saw, and the division

completed with ordinary bone pliers. Whatever is used, care must be taken not to splinter the bone, but to leave a clean-cut surface. All hæmorrhage is then carefully arrested before opening the pleura. This is done by thrusting a director through the middle of the inner layer of periosteum, the subpleural fascia,

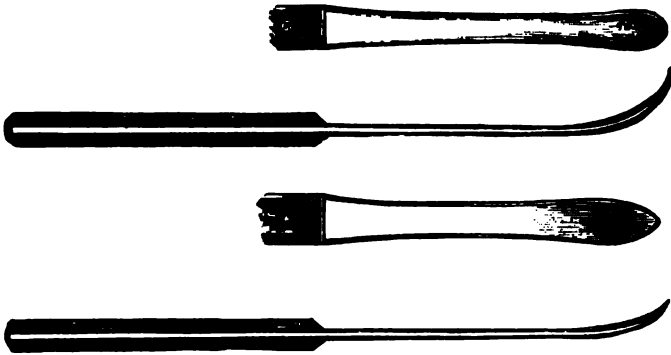


Fig. 712.—Raspatories used in the Operation for Empyema. The lower one is for stripping the periosteum from the outer surface of the rib; the upper more curved one is for stripping it from the subcostal groove and inner surface of the rib.

and the pleura; when pus appears in its groove, a knife is passed along it, and the opening enlarged to the full length of the bone removed, care being taken to cut above and parallel with the intercostal vessels. The pus immediately escapes, and air is sucked in. The finger should be introduced to explore the size and position of the cavity, and feel for adhesions and masses of lymph. Unless the lung is bound down by very firm adhesions, it will be felt to expand under the finger, in spite of the free

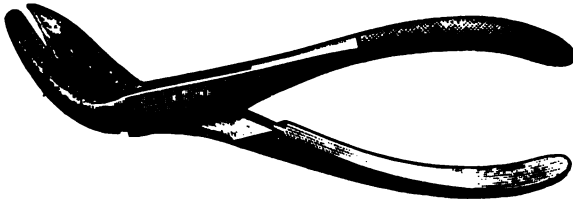


Fig. 713.—Rib Forceps.

admission of air to the pleura. Even when the cavity is so large that at first the lung cannot be felt with the finger, by the time the dressing is applied there may be hardly any appreciable cavity left, owing, in great part, to the expansion of the lung. If the older operation is preferred, the incision is carried carefully down to the pleura, then all hæmorrhage is arrested, and after that the pleura is freely divided.

Cleansing the pleura.—Many surgeons prefer to do nothing more than allow the pus to escape through the incision held agape with dressing forceps, regarding further interference as both dangerous and unnecessary. Others, myself among them, prefer to remove all the pus and the masses of lymph often found, and to clean the cavity as thoroughly as that of any other abscess, believing that this expedites recovery. The masses of lymph are conveniently removed with ovum forceps. The cavity can be cleansed by gentle irrigation with a warm antiseptic solution, such as boric acid lotion at 100°; the fluid must be allowed to flow in with very little pressure, and the wound must be held open to allow of its ready exit. The patient should then be turned over, so that the opening is dependent, and after the fluid has ceased to run, what remains may be removed by gently wiping out the cavity with swabs of aseptic wool. Or,

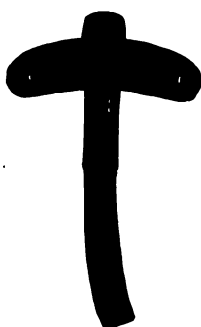


Fig. 714.—Empyema Tube.

without any preliminary washing out, the cavity may be dried and cleansed by the careful use of antiseptic swabs. These manipulations should all be very gentle; they should on no account sever adhesions, and should not be continued if they excite hæmorrhage or coughing.

If cough is troublesome, it is a good plan to cover the wound with a pledget of wet antiseptic wool, and to wait a little. If, as occasionally happens, the escape of pus is followed by hæmorrhage, the tube should be inserted, the wound dressed as quickly as possible, and the patient placed in bed on the side operated upon. In two cases recently under my care, where the hæmorrhage from the pleura was very abundant, this treatment was quite successful, and convalescence proceeded satisfactorily.

The *empyema tube* should just reach the pleural cavity, and not project far within it; it should be incompressible by the ribs, have no lateral holes, and be so fixed that it cannot slip into the chest or out of the sinus. The best form for use immediately after the operation is that represented in Fig. 714; it consists of a vulcanite tube, to which is attached a closely-fitting red rubber tube, and a broad flange of red rubber. When in place, the vulcanite part lies between the ribs, the soft tube projects into the pleura, and the whole is held in place by tapes attached to the flange and tied round the chest. After two or three days this tube may be replaced by one of the same size of red rubber, the outer end of which is split for an inch or more, the two halves forming a flange, by which it is tied and fixed in position. As the ribs fall in, the sinus becomes oblique and longer, and it may be necessary to use a longer tube. The calibre of the tube should not be reduced, and care should be taken to have its end always just reaching the pleural cavity. It should be removed as soon as the pleural cavity is closed and the wound

consists of a sinus in the chest wall only. This may be ascertained by the amount of discharge, by the effect of coughing, and by the freedom with which a bent probe can be rotated beyond the sinus. When there is merely a sinus, the tube should be removed at once—not gradually shortened—and cicatrization will quickly ensue.

The *dressing* should be antiseptic and abundant. The discharge

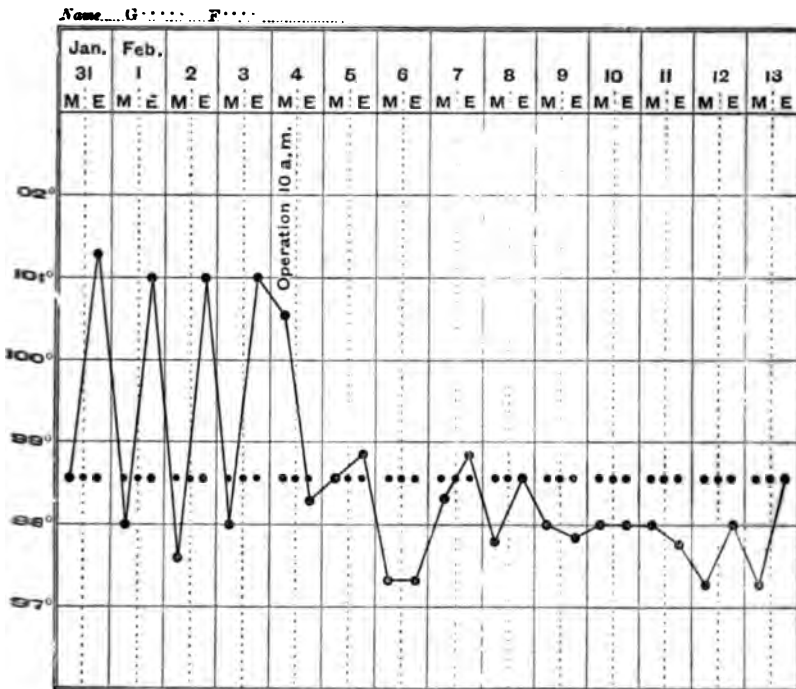


Fig. 715.—Temperature Chart of a Case of Empyema, showing the effect of the operation of draining of the pleura.

at first may be copious, but it should quickly be reduced to a little serum, and then the bulk of the dressing can be lessened. While the discharge is profuse, the dressing must be frequently changed; subsequently a change is needed only every day or less. A good form of dressing is a pad of double cyanide gauze over and around the tube, covered by a thicker and larger layer of boric wool or carbolised tow, fastened on by a binder round the chest. The temperature should fall to the normal as soon as the empyema is drained, and remain so until healing is complete. (See Fig. 715.) In some cases of large empyema the tube may be removed before the cavity is obliterated, if the discharge is only slight in amount

and serous in character. A few days later the pleural cavity should be tapped to learn the character of the fluid—if purulent and abundant the pleura must be redrained,—if there are no subjective symptoms, and the discharge is only serous and in quite small quantity, the patient should be watched, and tapped again, and

then in all likelihood the effusion will be found still much less, and still serous.

The *process of cure* of an empyema is interesting. The diaphragm rises, the mediastinum passes over to the diseased side, and the ribs fall down and in. Combined with this is an active expansion of the lung, unless too firmly bound down against the spine. This expansion can often be plainly felt at the time of operation; two explanations of it may be offered. It may be due in part to the unimpeded circulation through the pulmonary capillaries opening out the lung, but it is due still more to the fact that the resistance to the air is less in the compressed lung than at the



Fig. 716.—Photograph of a Patient after Drainage of a large right-sided Empyema.

glottis, and, therefore, with each expiration air is forced from the opposite into the collapsed lung. It has been shown that in coughing and forced expiration air passes from the lower parts of the lungs into the imperfectly-supported apices of the lungs; the same thing happens to a still more marked extent after opening an empyema, and the coughing that usually occurs is very useful in expanding the compressed lung. When the two surfaces of the pleura come in contact, adhesions quickly form between them, and then the movement of the chest wall directly pulls upon the lung during inspiration, and expands it. The degree to which the compressed lung recovers itself appears to depend chiefly upon the density of the visceral pleura—the so-called adhesions binding it down—and upon the time during which it is compressed. It is, therefore, very important to evacuate the fluid early. Occasionally, even early operation is not followed by expansion of the lung. When the pleural cavity is closed expiratory effort is of no further use in enlarging the collapsed lung, but air is drawn into it in inspiration, and therefore

gymnastic exercises which expand the chest are of distinct value in opening out the lung still more.

The degree of flattening of the chest that persists is fairly shown in the accompanying photograph (Fig. 716), and in the cyrtometric tracing of the same patient's chest (Fig. 717).

Fistulous empyema may be met with after spontaneous or surgical evacuation of the pus. In some cases the fistula is due to necrosis of the rib, and is easily cured by removal of the sequestrum. In most cases it is due to imperfect drainage of the cavity, either from the opening being too high up, or too small, or of a valvular

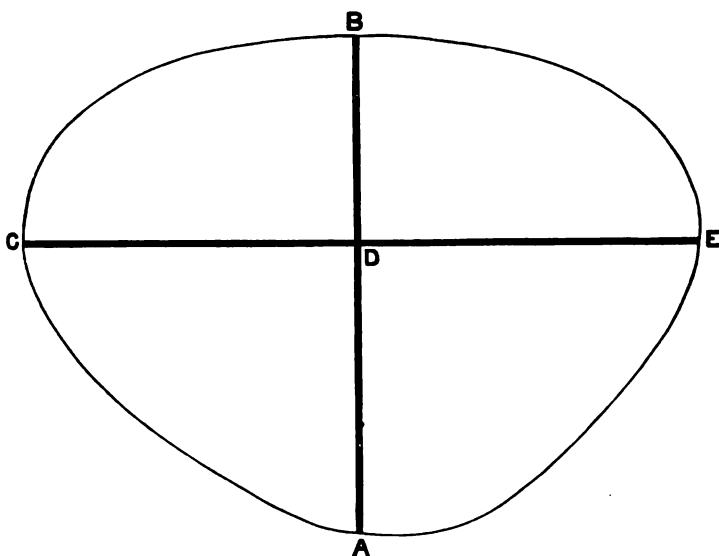


Fig. 717.—Cyrtometric Tracing of the Chest of the Patient in Fig. 716, taken at the level of the nipples.

nature; in these cases, complete drainage should be secured by a second opening, or by enlarging the existing one. The most serious cases are those in which, in spite of free drainage, the pleural cavity remains unobliterated, from failure of the lung to expand and of the chest to fall in, until the surfaces come together. In these cases thoracoplasty should be performed.

Empyema communicating with a bronchus.—These cases should be treated in the usual way by an external incision, and although recovery takes longer than in simpler cases, it may be confidently anticipated.

Double empyema is a very grave condition, and, happily, not common. It is more often met with in children than in adults. Its treatment demands the utmost care. Aspiration should first be tried, and if that fails to cure, the two pleural cavities should be drained. The two sides should not be opened at the same operation,

but an interval of a few days or a week should elapse between the two operations. It is remarkable how good a recovery, with full expansion of both lungs, may follow; this is shown by Fig. 718, taken from a photograph from life of a patient lately under the writer's care. We have seen (page 414) that simultaneous wound of both pleuræ is almost invariably fatal from collapse of the lungs. Such a result does not follow the simultaneous drainage of both



Fig. 718.—Photograph of a Child taken one Year after Recovery from Double Empyema, treated by drainage of both pleural cavities.

pleuræ for double empyema, for the inflammation has entirely altered the conditions: when the pleura is opened in a case of empyema, further collapse of the lung is prevented by the adhesions which always exist. Indeed the very opposite effect is produced, for on removing the fluid which has been compressing the lung, it at once expands. It is a striking and, apparently, a paradoxical fact, that an operation which, if performed on the healthy, would be invariably fatal in its effects, is a valuable means of saving life when employed in conditions of disease.

Thoracoplasty, or Estlander's operation, is employed in cases of

chronic fistulous empyema in which the continued suppuration is due to failure of the three forces of expansion of lung, displacement of parts, and falling in of the chest wall, to bring the two surfaces of the pleura into contact. It accomplishes this by removing the ribs bounding the cavity externally, and aims at converting a rigid into a yielding collapsible wall. It is a severe operation, and should be strictly reserved for cases in which all other measures have failed. When successful it leads to healing of the empyema and the arrest of suppuration, but it does not lead to any expansion of the lung, or to any increase of its function, and it generally causes great deformity (Figs. 719—722). The varying results that are obtained are well shown in the accompanying photographs of patients that have been treated by the writer. Figs. 719 and 720 show the chest of a youth, aged nineteen, from whom the second to the seventh ribs inclusive were removed on the right side from their anterior ends to the level of the scapula. He recovered with very little deformity, and is well

and strong. Previous to the operation the empyema cavity held a pint and a half. Figs. 721 and 722 show the chest of a youth from whom the second to the sixth ribs on the left side were removed over seven years before. It shows very great deformity, and the lad is very delicate and weakly. The difference in these cases is partly due to the arrest of growth in the second case.

The cavity having been carefully explored with a probe to ascertain its limits, a vertical incision should be made over it, by preference in the axillary line. The periosteum of each rib in turn should be divided and stripped from the bone as far as the limits of the cavity

extend, and the bone divided at each end and taken away. The ribs as high as the second may be thus removed if necessary: it is rarely necessary to go below the seventh. They may be severed as far back as the tubercles, and in front at their junction with cartilage. The operation is best done without



Fig. 719.—Front View of a Patient after Recovery from an extensive right Thoracoplasty, showing a very good result. (From a photograph.)



Fig. 720.—Back View of a Patient after Recovery from an extensive right Thoracoplasty, showing a very good result. (From a photograph.)

making any fresh opening into the pleural cavity, but if preferred the ribs may be removed from the inside. The inner surface of the pleura should be carefully scraped and well irrigated with a suitable antiseptic, and the wound is then closed over a drainage-tube and dressed with a pad of antiseptic gauze and wool, pressing the pleural surfaces in apposition. If the pleura is so thick and dense that it affords an obstacle to closure of the cavity, it should be either divided into circular strips, by incisions between the intercostal vessels, or removed. If the operation is decided upon it should be done completely, and all the bone bounding the unhealed cavity taken away.

2. The surgical treatment of diseases of the lung.

Pneumotomy or opening cavities in the lung.—This operation is undertaken in cases of abscess in the lung, localised gangrene of the lung, bronchiectasis and large phthisical cavities. The seat of the mischief having been defined as carefully as possible,



Fig. 721.—A Patient after Thoracoplasty.

the parietal pleura over it is exposed by removing a portion of rib. Pleural adhesions usually exist over pulmonary abscesses, but the surgeon must be prepared to find them absent. He therefore carefully divides the parietal pleura, and if not adherent he seizes the exposed lung and at once stitches it to the parietal pleura. The wound may then be lightly stuffed and dressed, and after two or three days, when adhesions will have formed, the operation may be completed. But the operation may be completed at once, and this is generally to be preferred. With a grooved trochar the exposed lung is pierced,

and when pus or putrid gas escapes along the groove, fine sinus forceps are passed in and the opening gently enlarged by dilatation rather than by cutting. The division of the lung may be made by a Paquelin's cautery. The pus of an abscess will then escape, or a slough may be ejected or removed, and a foreign body can be

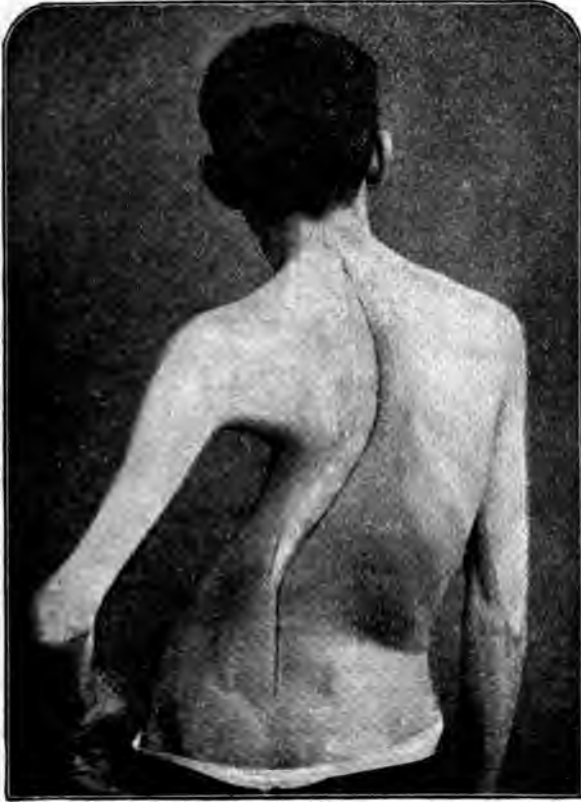


Fig. 722.—Back View of the Patient shown in front in Fig. 721.

searched for and extracted. A suitable drain is then placed in the cavity, and an external dressing applied. It is very important to bear in mind that if a patient with a freely discharging cavity in one lung is anæsthetised and then turned on to the sound side to facilitate the operation, the pus may run into the bronchus of the sound lung and asphyxiate the patient: I have known this to happen in more than one instance. On account of the same danger pulmonary cavities must not be irrigated. The insufflation

of iodoform, or the injection of a few minims of a fluid antiseptic, is not attended with danger.

Pneumectomy, or excision of a portion of a lung, has been suggested and actually practised for sarcoma of the lung and for tubercle. It is not yet a recognised surgical procedure.

Hydatid disease of the lung requires a special notice, because puncture or aspiration of the cyst has been proved to be a highly dangerous operation. As the hydatid cyst collapses, the fluid within it may pass into the bronchioles of the lung surrounding it, and in such quantity as to cause speedy death from asphyxia. Where

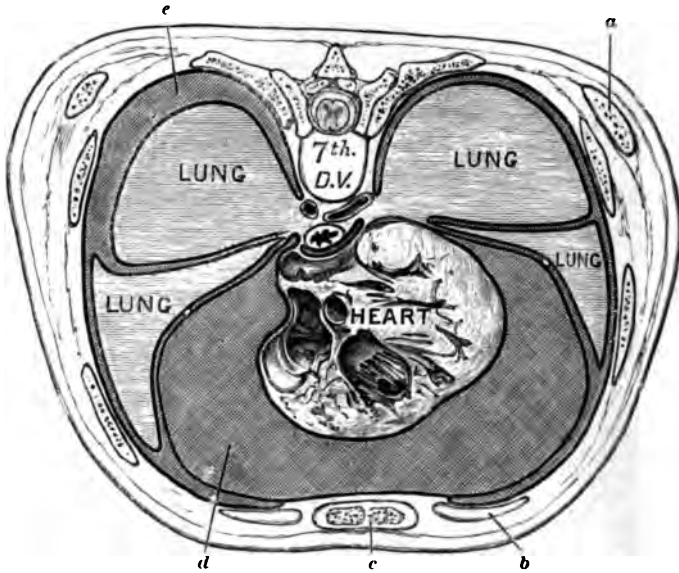


Fig. 723.—Transverse Section of the Chest in a Case of Pyocardium.
a, scapula; b, costal cartilage; c, sternum; d, pericardial effusion; e, pleural effusion.

hydatid disease is suspected, therefore, exploratory puncture or aspiration should not be practised, but the operation of pneumotomy should be performed, and a free opening at once made into the cyst.

Hydatid of the pleura causes very serious compression of the lung and great displacement of parts. Its puncture is not attended with danger, but the proper treatment is removal of the cyst through a sufficient opening in the chest wall. The cavity left after removal of the cyst closes slowly.

3. The surgical treatment of pericardial effusions.

Paracentesis pericardii is now a well-recognised procedure in cases of pericarditis with effusion. An aspirator should be used. The best place to insert it is through the fourth or fifth intercostal space two inches to the left of the sternum. Another safe place is in the fifth space close to the left border of the sternum.

to be avoided in the puncture are the intercostal and internal mammary vessels, the left pleura, the heart, and the great vessels.

Drainage of the pericardium is practised in cases of *pyopericardium* (Fig. 723). The opening may be made through the fourth or fifth interspace, or by excising the fifth left costal cartilage. The incision is carried carefully down to the pericardium, and when all hæmorrhage is arrested, that sac is opened, the pus evacuated, the interior of the cavity cleansed, and a large drain fixed in the wound. The pericardium may be opened in the same way for the removal of blood or of a foreign body. It is a good plan to stitch the pericardium to the chest wall before opening it. If this is not done, the sac may so collapse when opened that the contained fluid escapes into the mediastinum, and difficulty may be experienced in inserting the drainage-tube.

Paracentesis cordis—tapping the heart—has been proposed as a substitute for phlebotomy in cases of great engorgement of the right side of the heart, and it is asserted that the removal of a small quantity of blood directly from the heart produces a greater beneficial effect than the withdrawal of a much larger quantity from the systemic veins. The right auricle may be tapped by a trochar introduced through the third right interspace close to the sternum, or the ventricle by a trochar passed through the fourth right interspace one inch and a half to two inches from the middle line of the sternum.

4. Surgical diseases of the chest walls.—In addition to those already mentioned (page 399), certain affections of the chest wall frequently come under surgical treatment.

Sebaceous cysts, lipomata, and gunnata are not infrequent, but present no peculiar features.

Caries and necrosis of the sternum and ribs is often tuberculous in origin, and runs a very chronic course. The only effectual treatment is careful and complete removal of all the diseased and infected tissues, with thorough cleansing of the wound.

Syphilitic caries and necrosis of the sternum and ribs is also not uncommon; sequestra should be carefully removed when loose, and the disease combated by full doses of the iodide of sodium in appropriate combination.

Tuberculous perichondritis with necrosis of the costal cartilage runs a very slow course, sometimes extending over years. The part should be well exposed, and all the diseased cartilage removed, care being taken to go beyond the limits of the disease rather than to stop short of them. It is often very difficult to distinguish the dead from the living cartilage.

Tumours.—The most common tumours of the chest wall are carcinoma and sarcoma, secondary to similar growths in the mamma. These, when not involving the sternum, ribs, or intercostal muscles, may be removed.

The following primary growths are also occasionally observed:—

Chondroma of the ribs is a rare form of this growth. Gurlt found only three instances among 14,639 cases of tumours of all

kinds, and out of 237 cases of chondroma collected by Weber there were only seven of the ribs. Schlöpper has brought together twenty-eight cases of this form of disease. These tumours may consist of pure cartilage, but more often the cartilage is mixed with myxomatous, fibromatous, or sarcomatous elements, and such mixed tumours are described under different names by various observers.

They occur most often between the ages of thirty and forty. They grow especially from the anterior part of the ribs, most often springing from the junction of the ribs and cartilages. Rare cases have been met with posteriorly, and these are liable to cause serious symptoms by pressure on the spinal cord. Several cases are recorded in which the growth of the tumour has quickly followed upon a fracture of the rib at the same spot. Similar growths from the sternum are very rare; in that situation they may cause grave pressure upon the mediastinum.

The tumours grow slowly at first, then more quickly. They form round, lobed, sessile masses immovably fixed to one or more ribs. They are very firm in consistence, but in the later stages softer portions and even fluctuating areas may be found. They may grow entirely on the outer aspect of the ribs, or they may spread inwards, and press on the lung or diaphragm. They are malignant in nature, for they give rise to secondary growths in the lung, and may recur locally when removed.

As soon as recognised, the tumour should be freely removed. The soft parts should be reflected from the growth, and the ribs to which it is attached should be divided a little distance on each side of the tumour. With care, the tumour and attached ribs should then be separated on the deep aspect by dividing the intercostal muscles down to the sub-pleural fascia. The intercostal arteries are tied as cut, and the mass gently separated from the pleura. If it is found that the pleura is firmly adherent to the tumour, the serous membrane must be divided, and quickly sutured, pains being taken not to infect the cavity nor allow blood to enter it. In some cases the diaphragm and the peritoneum have been wounded in the operation. Such wounds must be carefully closed with sutures.

Sarcoma of ribs and sternum.—Primary sarcomata are more common in the sternum than the ribs. They may be either central or periosteal. They are much more malignant than the tumours last considered. Their growth is rapid. They quickly lead to secondary deposits in the lungs and other internal organs, and to effusion into the serous sacs of the chest. If met with in an early stage, complete excision of the tumour should be practised.

Pigeon breast is a common deformity produced in children by the yielding of the chest walls under atmospheric pressure during inspiration. When from any cause—such as diphtheria, laryngeal papilloma or stenosis, chronic pulmonary catarrh, post-nasal adenoids, or enlarged tonsils—there is an obstruction to the entrance of air during inspiration, if the chest walls are weak they yield under the pressure of the atmosphere, especially in the rib cartilages and at the

junction of the ribs and cartilages. When the obstruction is great, the chest may be seen to sink in during inspiration, and the deformity so produced generally takes the form of pigeon breast. This consists in a protrusion forwards of the sternum, and a straightening of the ribs in front of their angles. In extreme cases the widest part of the chest is between the angles of the ribs. It is often associated with more or less of a lateral constriction running outwards from the xiphoid cartilage. The effect of the deformity is to lessen the size of the chest and the degree to which it expands during inspiration. A somewhat similar deformity is produced by the falling down of the upper dorsal vertebræ from tuberculous disease of the bones. Great distortion of the chest is seen in cases of severe scoliosis, and after empyema with permanent collapse of lung. The most extreme degree is seen after extensive thoracoplasty.

Apnoea literally denotes "breathlessness"; the term is used to describe the cessation of respiration which results from hyperoxygenation of the blood.

Asphyxia literally means "cessation of the pulse," but it is always employed to denote the result of a total interruption of respiration, or suffocation.

XLV. AFFECTIONS OF THE MOUTH, PALATE, TONGUE, TONSIL, AND PHARYNX.

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CONGENITAL MALFORMATIONS OF THE FACE AND MOUTH.

Development.—In order to render intelligible many points concerning the origin of the congenital malformations of the face

and mouth, it is necessary to pass under review certain facts regarding the development of the parts in question, since the various malformations are due to some disturbance of their normal development during the first weeks of intra-uterine life.

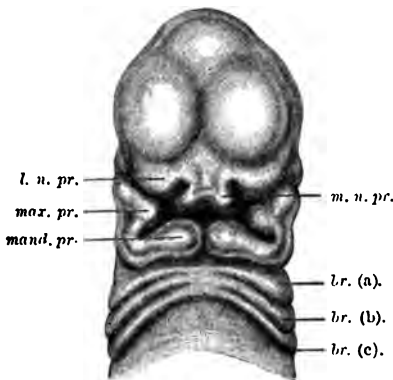


Fig. 724.—Head of a Fœtus. (Semi-diagrammatic, and modified from several illustrations from His.)

l. n. pr., Lateral nasal process; *m. n. pr.*, mesial nasal process; *max. pr.*, maxillary process; *mand. pr.*, mandibular process; *br. (a)*, *br. (b)*, *br. (c)*, the three lower branchial arches.

It is as early as the end of the second week of fetal life that the four cephalic, visceral, or branchial clefts or furrows make their appearance, and a little later are seen the four branchial arches. Of these arches the first is placed between the stomodæum or primary mouth cavity and the first branchial cleft or furrow (Fig. 724).

By the union of the three lower arches with one another and across the midline with those of the opposite side, the neck is formed.

The face is developed by the blending of five processes around the primary mouth orifice, which latter is represented at first by a shallow depression, which soon deepens to form the cavity of the mouth.

Below the opening of the mouth is the mandibular bar, formed by the union (completed in the fifth week) of the first pair of branchial arches. On each side the maxillary process is seen, which has grown as a bud-like projection from the upper border of the root of the first branchial arch, to close the gap between the mandibular bar below and the fronto-nasal process above.

The fronto-nasal process which, projecting downwards from the anterior part of the base of the skull, insinuates itself between the two maxillary processes, soon divides into two lateral projections and a median portion, which latter shortly afterwards splits into two segments, that lie on either side of the mesial line (Fig. 724). There thus result four mammillated processes, two on each side, which may be termed the mesial and lateral nasal processes; and between each pair of these projections lies the olfactory groove. The maxillary process is now separated only by a narrow cleft from the external margin of the lateral nasal process, with which it later unites. From the maxillary process of each side are derived the cheek, the lateral part of the upper lip, the soft palate, and the superior maxillary bone, exclusive of the intermaxillary segment.

The mode of formation of the palate is as follows:—From the buccal aspect of the maxillary process of either

side springs the palatal process, which passes inwards to blend with its fellow of the opposite side, to form the soft palate and the whole of the hard palate except the intermaxillary portion. The palatal processes make their appearance during the seventh week; and union between them, which proceeds from before backwards, is completed by the tenth week.

The fronto-nasal process gives origin to the external nose, the ethmoid, the vomer, the cartilaginous septum, the median portion of the upper lip, and the intermaxillary bone.

According to Albrecht, there are four intermaxillary segments, each of which springs as a shelf-like projection from the buccal aspect of the corresponding mesial or lateral nasal process of its own side. Each of these segments, triangular in section, gives origin at its base to the rudiment of an incisor tooth. The four apices converge towards the anterior palatine canal (Fig. 725). Each mesial intermaxillary segment may be named an endo-gnathion; each lateral segment a meso-gnathion; the maxilla is the exo-gnathion.

From the mandibular bar are developed the lower jaws, the

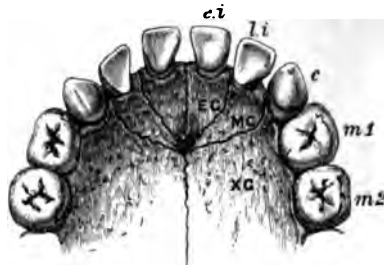


Fig. 725.—Diagram representing the normal Development of the upper Jaw according to Albrecht.
EG, Endo-gnathion; MG, meso-gnathion; XG, Exo-gnathion. The five intermaxillary sutures are well shown.

overlying soft parts (the lower lip and chin), and the floor of the mouth. By the tenth week all the various fissures should have become closed, and the face be duly formed in miniature.

We may now proceed, by the light of these developmental data, to endeavour to elucidate the various congenital deformities to which the face is liable. It will be convenient first briefly to discuss the rarer varieties.



Fig. 726.—Mr. John H. Morgan's Case of Macrostoma with Auricular Appendages.

Macrostoma (*μακρός*, great; *στόμα*, the mouth), or transverse enlargement of the orifice of the mouth, is due to the failure of union between the maxillary and mandibular processes of the first branchial arch. This condition, which may be bilateral or confined to one side, varies considerably in the extent of the fissure or cleft, which in slight cases may be merely a deficiency at the angle of the mouth, in more severe cases it may reach to the last molar tooth, or even to the auricle. Any intermediate stage may be met

with. The malformation may be associated with other deformities, such as deficient development of the brain or lower jaw, the formation of accessory auricular appendages (Fig. 726), facial cleft, hare-lip, or cleft palate. When the cleft is extensive the nutrition of the child is prone to suffer, as there is difficulty in retaining the food in the mouth. There is, further, a constant escape of saliva from the buccal cavity. Operative treatment therefore becomes a necessity. The margins of the cleft must be carefully pared, and then united by sutures, special care being taken to approximate accurately the cut edges of the mucous membrane. The result of such a procedure is, as a rule, very satisfactory.

Microstoma.—In striking contrast to the above-mentioned malformation is the condition designated microstoma (*μακρός*, small; *στόμα*, the mouth), or congenital *atresia oris*, in which the orifice of the mouth is unduly contracted, so much so in marked cases that a probe cannot be passed. This stenosis or narrowing is caused by the fusion between the maxillary and mandibular processes passing beyond the normal degree. The opening of the mouth may be contracted almost to a pin-hole orifice. **Microstoma**

is not infrequently seen in association with deficiency of the lower jaw.

In slight cases no treatment may be necessary; but when the condition is well marked, a plastic operation, having for its object the elongation of the orifice, must be undertaken. This may be accomplished by making a transverse cut through the cheek on either side of the orifice, and then suturing the edge of the mucous membrane to that of the skin.

Microstoma must not be confounded with the far more common condition of acquired stenosis of the opening of the mouth, the result of cicatricial contraction following burns, ulcerative processes, etc.

Facial cleft is an exceedingly rare malformation; it is due to failure of union between the lateral nasal and the maxillary processes. The cleft, which may be bilateral, extends from the red margin of the upper lip to the middle of the lower eyelid, more rarely to the inner canthus, or across the orbit into the temporal region (Fig. 727). This cleft involves, as a rule, the soft parts alone; very rarely does the fissure extend through the facial bones. The cleft may be closed by operative procedures, but much scarring of necessity results.

Mandibular cleft is due to failure of union between the two mandibular arches (the first branchial). So rare is this deformity that some surgeons have doubted its existence. The cleft may involve the soft parts alone, or the halves of the lower jaw may be ununited.

A small blind *fistula* is sometimes seen on either side of the mesial line of the lower lip, opening on the red margin of the lip by a small papilla. Such congenital sinuses may admit a fine probe, and have been observed one inch in length. They discharge a small quantity of mucus, are probably associated with some deficiency in the obliteration of the intermandibular cleft, and have been chiefly observed in patients suffering from double hare-lip.

Hare-lip, or congenital vertical fissure of the upper lip, may be median or lateral—the former variety being as rare as the latter is common.

Median hare-lip.—Two varieties of this condition may be met with. In one there is a wide median gap in the lip, the central



Fig. 727.—Mandibular Cleft and two Varieties of Facial Cleft.

segments of the intermaxillary bones (endo-gnathia) and overlying soft parts of the lip are absent, and the nose is flattened, owing to absence of the nasal septum. This condition is best explained by conceiving a double hare-lip with absence of the os incisivum (the fused endo-gnathia) and of the superjacent soft parts of the lip due to arrested development of the mesial nasal processes. The second variety of median cleft of the upper lip consists of a narrow fissure in the middle line of the lip. Only with extreme rarity are the endo-gnathia separated.

Let us now pass from these rare malformations to consider those which are very common, and, therefore, of far greater practical interest to the surgeon—namely, lateral hare-lip (ordinarily known as hare-lip) and cleft palate.

Lateral hare-lip is a congenital cleft of the upper lip, which may vary from a slight notch of the lip margin to a deep fissure, involving not only the soft structures of the lip, but extending into the nostril, the alveolar border of the bone, or even through the hard and soft palate (i.e. combined with cleft palate).



Fig. 728.—Unilateral (left-sided) Hare-lip. (From a patient at Charing Cross Hospital.)

Any stage intermediate between these two extremes may be met with. The fissure may be bilateral, or confined to one side; the latter being the more frequent condition. When unilateral the cleft is usually found on the left side (Fig. 728). This malformation, which is more common in boys than in girls, when

extending to the alveolar portion of the superior maxillary bone is called alveolar hare-lip. In all cases where the cleft is bilateral, and extends to the alveolus of the jaw, the palate is also fissured, and the os incisivum (the united endo-gnathia), with the portion of the lip between the lateral clefts, is usually more or less pushed forwards and rotated, so that the alveolar margin projects anteriorly (Fig. 729). In aggravated cases these structures, separated entirely from the upper jaw bone, and protruded by the nasal septum, gain adhesion to the under aspect of the tip of the nose, whence they project, producing a most unsightly appearance. In unilateral hare-lip the nose is usually broadened and depressed. The two margins of the cleft are often of unequal length, and the frænum of the lip is long, thick, and fleshy. In double hare-lip the portion between the two clefts is usually smaller than normal.

Causation of hare-lip.—Regarding the causation of hare-lip little that is definite can be stated, except that heredity is an important factor, and that the condition is due to non-closure of certain of the fissures in the region of the fronto-nasal process. When

heredity has been noticed, the tendency has usually been transmitted through the maternal parent, less frequently through the father.

Site of the cleft.—There are two chief conflicting views regarding the exact location of the cleft in hare-lip.

Th. Kölliker maintains that the cleft in alveolar hare-lip lies



Fig. 729.—Aggravated Example of Double Hare-lip with Protrusion of the os incisivum Viewed from the front and in profile. (From a patient at the Victoria Hospital.)

between the intermaxillary bone and the maxilla (meso-exognathic). He is further of opinion that the lateral nasal process does not take part in the formation of the upper lip, and that the labial cleft, therefore, is due to non-union of the mesial nasal with the maxillary process.

Albrecht, on the other hand, holds that both the mesial and lateral nasal processes assist in the formation of the lip, and that also from each of them a segment of the intermaxilla is derived, making four segments in all, in contradistinction to Kölliker, who states that the bone is formed of two segments only.

Albrecht locates the cleft between the mesial and lateral nasal processes—i.e. between the endo- and meso-gnathion (Fig. 730). There is little doubt that Albrecht's view best explains the great majority of these deformities, in which the cleft runs between the

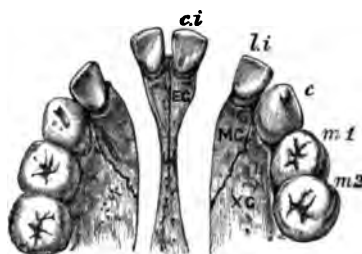


Fig. 730.—Diagram representing double Alveolar Hare-lip according to Albrecht's view.

xo, The exo-gnathion; mc, the meso-gnathion; ec, the endo-gnathion. The os incisivum bearing the two central incisors is shown. It is manifest that the cleft is endo-mesognathic on each side.

central and lateral incisors, and is, therefore, clearly endo-mesognathic. Still there are certain cases in which the cleft in the alveolar border runs external to the lateral incisor—*i.e.* the cleft is meso-exognathic.

It will be clear, owing to the mode of development and formation of the palate, that when hare-lip is combined with a more or less extensive cleft of the alveolar border and of the palate, the fissure, whether unilateral or bilateral, will extend from the alveolar margin backwards and inwards to the region of the anterior palatine foramen, from which point, in complete clefts of hard and soft palate, it will be continued backwards in the middle line to the bifid tip of the cleft uvula. In double alveolar hare-lip with cleft palate the total cleft will be Y-shaped.

Treatment of hare-lip.—The condition of hare-lip always demands closure of the fissure, the only debatable point being the age at which this should be undertaken.

In attempting to decide this important question, it must be clearly understood that we are here dealing with clefts of the lip alone. When such co-exist with cleft palate, the labial fissure is always to be united first; the closure of the palatal cleft being postponed for some considerable time on account both of the greater danger to life of the latter procedure, and of the need that exists for the intelligent co-operation of the patient in the after-treatment.

Many surgeons operate very early—*i.e.* in the first few days of life. Their reasons for so doing are that, in their opinion, at this early period of life the infants are very little sensitive to pain, that they sleep the greater part of the day, and, therefore, cry less than children a few months older, and that unless the operation be thus early performed their nutrition is apt to be seriously endangered, owing to the difficulty of administering food. Excellent results have undoubtedly followed this plan of treatment, especially in the hands of König, who reports seventy cases, with only one death (from erysipelas). There are, however, very cogent arguments to be advanced against this method of treatment; among them being the fact that at this early age the soft parts of the lip are extremely lacerable, that children only a few days old bear the loss of even a small quantity of blood very badly, that in all but the slightest clefts the operation is of some severity, and that in these slight cases there is no urgent call for its performance; moreover, the difficulties attendant on the feeding of these children have been much exaggerated.

For these and other reasons it is, therefore, advisable not to attempt to close the labial fissure at too early an age. The great majority of British surgeons prefer, with good reason, to defer the operation until the sixth week at the earliest. In general terms it may be laid down that the best time for this operation to be undertaken is from the sixth week to the sixth month—*i.e.* before the disturbances of teething supervene. The slighter the fissure the earlier can the

operation be performed ; the greater the deformity the greater, of course, will be the risk of operative treatment. In all cases the vitality of the child and the extent of the deformity will be our best guides in determining when the operation may be undertaken. In severe cases, especially in extensive double hare-lip, it is the part of wisdom to wait at least until the third or fourth month of life.

It is hardly necessary to add that, should any morbid condition of the mouth or nose be present—as aphthous stomatitis, nasal catarrh, etc.—it is needful to cure this before proceeding to operative treatment.

It has been indicated above that the difficulty of administering food to the infant suffering from hare-lip, and even cleft palate, has been by some surgeons much exaggerated. It is not to be denied that a certain amount of difficulty undoubtedly exists in the majority of cases, but this is by no means insuperable, and can be overcome by careful nursing. If the fissure be confined to the lip, and be not too wide, the child can take the breast if the nipple is of good size ; if wider and complicated with cleft palate, an extra-large teat provided with a large perforation will in many cases enable the child to drink from the bottle. In the worst cases feeding by means of a spoon must be resorted to. In spoon-feeding it is essential that the child's head be well thrown back, and that the milk be dropped into the pharynx. Unless this be done carefully there is risk of the child dying of starvation.

The treatment of hare-lip must be operative ; no amelioration of the condition can occur without operative treatment, the reverse rather is the case, the cleft tending to become more marked as age advances. There are numberless methods and modifications of operative procedures employed by various surgeons for the cure of hare-lip. It will suffice here to state the general principles which should underlie the treatment of the condition, and briefly to mention a few of the more generally useful methods.

The edges of the cleft must be accurately pared, the raw surfaces brought into immediate apposition, and retained by sutures until such time as primary union can occur. Accurate suturing of the mucous edges is of even greater importance than of the skin margins, for in those unfortunate cases in which primary union does not occur, it will nearly always be found that the breaking down of the recently glued surfaces has commenced on the deep or mucous aspect of the lip. It is, therefore, of prime importance to insert carefully the sutures uniting the raw margins of the mucous membrane, and for this purpose eversion of the lip is usually required. Union by first intention must be obtained if possible, as secondary union, when it does occur, leaves unsightly scarring. Should no union occur, the child is, of course, in a worse position than before the operation. The red margins of the lip must be accurately sutured, so that they may be exactly in a straight line after healing has occurred. As, however, there is always a tendency to the formation of a notched depression in the lip as a

result of the operation, it is advisable to guard against this by leaving a slight projection at the free margin of the lip after suture has been performed. This prominence always disappears in the course of a short time, owing to the contraction of the cicatrix. The lip must always be freely separated from the alveolus, so that no tension may exist after the sutures have been tied.

Operation for single hare-lip.—Of the numberless operative procedures which are associated with the names of their inventors, it will be sufficient here to mention three of the best, one or other of which will be found applicable in almost any case of single hare-lip.

Nélaton's method (Fig. 731).—This procedure is only to be recommended in the somewhat unusual cases in which the fissure does not



Fig. 731.—Nélaton's Operation for Single Hare-lip. (From Treves's "Operative Surgery.")

extend throughout the entire depth of the lip, but ends at some distance from the nostril. An incision of the shape of a reversed V is made above and around the apex of the notch, which is then pulled downwards so that the Λ -shaped wound becomes diamond-shaped \diamond . The raw surfaces of opposite sides are then approximated by suture. As a result there is left in the place of the notch a projection at the red margin of the lip. This, however, disappears in the course of a few months at the latest. It will be noticed that in this procedure none of the tissue of the lip is cut away, there is thus no loss of substance. This is an obvious advantage.

I very seldom employ Nélaton's method as a primary operation in cases of hare-lip, but frequently make use of it in instances in which an unsightly notch is left at the lip margin after an operation for hare-lip has been performed by some other method. In such cases, and they are by no means rare, the deformity may with much ease and safety be removed by the performance of Nélaton's operation.

Rose's method (Fig. 732).—When the two margins of the cleft are more or less symmetrical, this method will be found to be simple of execution, and to give very satisfactory results. A very fine sharp knife is inserted at the apex of the cleft, or in fissures extending into the nostril as high as convenient; a downward cut is now made on each side with its convexity directed away from the cleft edges, until the red margin of the lip is encountered. At this point the knife is then inverted, and made to cut inwards and somewhat upwards into the cleft. The cut surfaces are now sutured, and a

slight projection at the margin of the lip remains for some time, but eventually disappears. This procedure results admirably in about 70 per cent. of all cases of single hare-lip. It may be mentioned that the advantage of a concave incision was pointed out by Syme.

Mirault's method (Fig. 733).—There are certain cases, however, in which the above-mentioned methods fail to give a satisfactory result. I refer to those clefts in which the gap is extensive and wide, and more particularly to those in which the margins of the fissure are of different lengths and very unequally curved. For all such cases (about 30 per cent. in number) the method of Mirault is very serviceable.

By reference to Fig. 733 it will be seen that, in addition to paring the edges, a flap is formed comprising the lower third of the external margin of the cleft, and that the opposite (mesial) margin of the cleft is pared angularly, so that the flap may be accurately applied to it. If care be taken to make the flap sufficiently fleshy and substantial, this method will be found to yield excellent results.

Several complicated and extensive procedures are described in works on operative surgery; but it will be found that, provided



Fig. 732.—Mr. W. Rose's Method of Operation for Single Hare-lip. In A the line of incision is shown with its convexity directed away from the sides of the cleft. The obliquely-directed upward and inward incision is in the figure represented rather too long and too oblique. In B the margins are brought together by sutures of silkworm gut. (Slightly modified from Rose on "Hare-lip and Cleft Palate.")

the soft parts are freely, and in severe cases of hare-lip extensively, separated from the bone, so as to enable the raw margins of the cleft to be sutured without tension, the cases are very few indeed in which either Rose's, or Mirault's method cannot be satisfactorily employed.

Operation for double hare-lip.—In the great majority of these cases it will be found that Rose's method (Fig. 734) answers admirably. The outer margin of each cleft is pared, as in the operation for single hare-lip. The central portion, always deficient in size, is pared laterally, so that it becomes V-shaped. Sutures are then inserted, and the line of union has the Y shape shown in the figure. A modification of Mirault's method, performed on each side with thick flaps, which meet under the central piece, to whose

pared lower margin, as well as to one another, they are sutured, has in my hands yielded even better results.

In double hare-lip complicated by protrusion forwards of the os

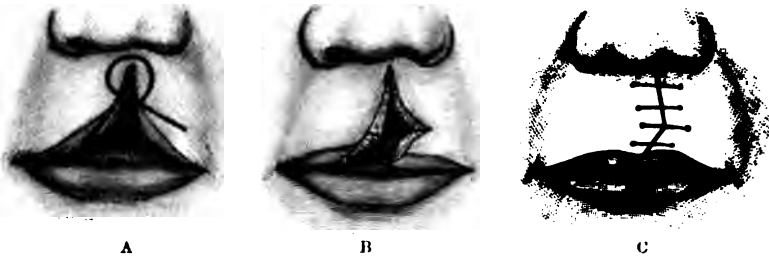


Fig. 733. —Mirault's Method of Operation for Single Hare-lip.

A shows the line of incision. B, the raw surfaces with the flap on the outer side. C, the margins brought together and united by suture.

incisivum, which in such cases is attached to the vomer, before any operation for suturing the cleft margins can be undertaken it is necessary to deal with this prominence. There are two chief methods of treating this projection.

The majority of Continental and a now increasing number of British surgeons advise the forcing back of the os incisivum into position after fracturing the vomer; or better, after subperiosteal incision of the vomer and cartilaginous septum, because fracturing the vomer not infrequently means fracturing the ethmoid, possibly



Fig. 734.—Mr. W. Rose's Method of Operation for Double Hare-lip. The central shrunken portion is pared laterally, so that it becomes V-shaped. Each outer margin is treated as in the operation for single hare-lip. A represents the margins brought together and united by suture. (Slightly modified from Rose on "Hare-lip and Cleft Palate.")

at the base of the skull. When the bone has been replaced, the fissures in the lip can then be sutured, and it is asserted that the cosmetic effect is much better, that the normal shape of the jaw is maintained, that the lip is kept in position and prevented from receding, and that the patient can in after-life use his own central incisor teeth.

These presumed advantages disappear, however, when we examine closely into the question. The most perfect cosmetic result is, I am

convinced, seen in cases in which the os incisivum has been removed, and its place supplied by a plate bearing artificial incisors, fitted by a skilled dental surgeon. In such a case the patient can bite firmly with these efficient substitutes, a thing he cannot do after replacement of the os incisivum, which is invariably, even years after the operation, more or less movable. Again, replacement of the bone necessarily implies rotation, as Ferguson pointed out, though many deny the fact. The result of this rotation is that the central incisor teeth (usually faultily developed) project backwards instead of vertically downwards, and are, therefore, equally useless and unsightly. A point of perhaps even greater importance is the fact that the os incisivum, forcibly replaced between the upper jaw bones and there retained *in situ*, acts as a wedge, tending to separate the latter, and thus to maintain the width of the cleft in the palate. After removal of the os incisivum it is usually, if not invariably, perceptible that the palatal cleft tends to become narrower, and this diminution in width renders its subsequent closure an easier and more satisfactory undertaking. For these reasons, therefore, it is probably the better course to remove in every case the protruding os incisivum before suturing the labial fissures. It is advisable to remove the os incisivum by bone forceps, which sever its attachment to the vomer, a few days before undertaking the suture of the lip. A few years ago, owing to the weight of the authority of Ferguson, almost all British surgeons were in favour of removing the os incisivum when (as usual) it formed a protrusion. At the present time there is a strong reaction in favour of its retention. I have little doubt, however, that before long, when the disadvantages of its retention have been fully appreciated, British surgeons will return to the original and radical measure advocated by Ferguson. I have lately had the opportunity of seeing four adults, in whom the ossa incisiva had been replaced in infancy. In three out of the four there was distinct mobility of the segment, and though in the fourth case the mobility was on examination scarcely perceptible, the patient assured me that he felt the part weak, mobile, and useless for biting anything but the softest food. In three cases the incisors projected backwards, in the fourth case they were almost normal in direction. In all they were either absent or deficient in size, stunted, and smaller than the lateral incisors. One patient asked whether the segment could not be removed; two of the remaining three were willing to undergo any operation, provided they could obtain firm fixation of the segment, the mobility of which caused them much annoyance.

Slight clefts of the lip in young infants may readily be sutured without the administration of an anæsthetic. In more severe cases anæsthesia is necessary, and due care must be taken to prevent the entrance of blood into the air-passages.

After-treatment of hare-lip.—A point of great moment is to have the little patient most carefully watched for several hours after the operation, in order to prevent what is quite a distinct

danger—viz. death from asphyxia. Several factors unite in tending to render difficult the respiration: the swelling and the tension of the often tightly sutured upper lip, the flattening of the nose, with perhaps partial closure of the nostrils and the blocking of the nasal passages with dried blood or mucus. The danger is to be obviated by either depressing or everting the lower lip, so as to increase the aperture for the entrance of air into the mouth; no instrument performs this manœuvre as satisfactorily as the finger of the nurse.

The child must be carefully fed with a spoon or a drinking-cup with a long spout, special care being taken to prevent any of the fluid food from touching the upper lip.

Regarding the time for removal of the sutures, it is better to leave them in too long rather than to remove them too soon. I always employ strong horsehair or fine-drawn gut, and do not remove them until the eighth or tenth day, before which time the child can usually take the breast. Hare-lip pins I have never found it necessary to use. They are not to be recommended. Accurate suturing of the pared margins of the fissure is amply sufficient.

Cleft palate. Varieties.—This is a congenital malformation of the palate, due to partial or total failure of union between the palatal segments of the maxillary processes. When the cleft extends forwards beyond the maxillary palatal processes it may traverse any of the intermaxillary sutures. It lies, however, commonly between the endo- and meso-gnathion, much less frequently is it meso-exognathic, and almost never inter-endognathic—i.e. between the two segments of the os incisivum.

Perforations of the palate are frequently caused by disease, especially syphilis, and much less frequently tuberculosis. To such conditions, however, we must not apply the term cleft palate.

Of other congenital defects of the palate, one is occasionally to be met with in which one or two small vertical clefts may be seen in the anterior pillar of the fauces, near to its junction with the tongue. This condition is very rare, but I have recently met with it in two members of the same family. It is due to the fact of the palatoglossus in the anterior pillar of the fauces having a separate mucous investment. A more remarkable condition is the presence of a congenital oval hole, situated at the junction of the hard and soft palate, and unassociated with other defect.

Extent of the cleft.—To return to the subject of cleft palate. The extent of the cleft may vary from a bifid uvula (Fig. 735, A) to an extensive fissure traversing the whole length of the soft and hard palate, extending anteriorly through the alveolus on one or both sides of the os incisivum, to end in a single or double fissure of the lip (Fig. 735, D). Between these two extremes any intermediate condition may be encountered. We may thus find a partial or complete cleft of the soft palate alone, without fissure of the hard palate (Fig. 735, B). In rare cases the hard palate, alveolus, and lip are

fissured, the soft palate being undivided. Clefts confined to the hard palate alone are almost unknown.

Behind the anterior palatine canal the cleft is usually spoken of

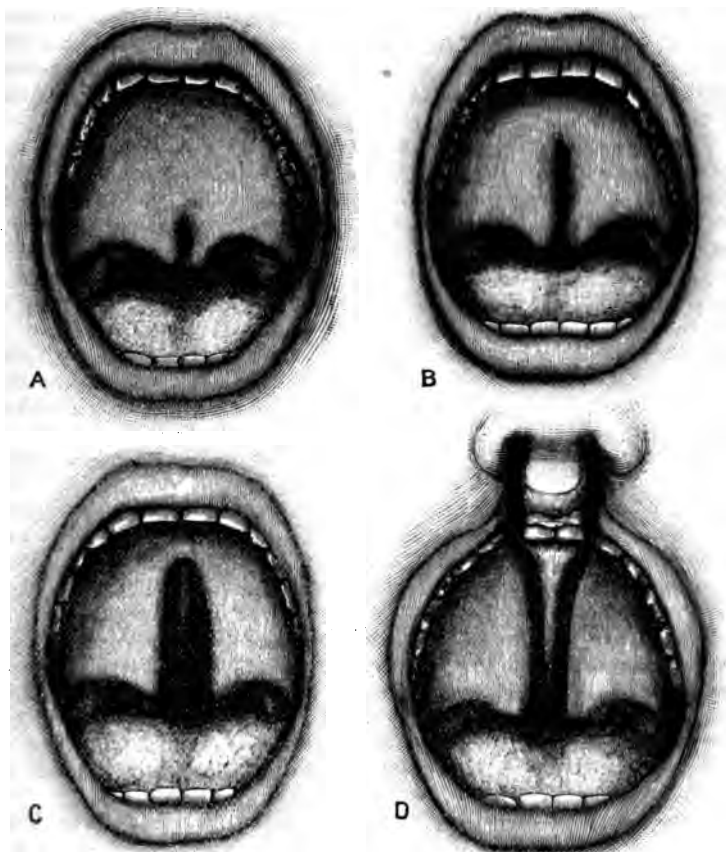


Fig. 735.—Four Varieties of Cleft Palate.

A shows a very slight degree of cleft palate—in fact, very little more than bifidity of uvula; B, a case of cleft of the soft palate; C, a more extensive cleft, involving the whole of the soft and the posterior third of the hard palate; the vomer is indicated in this drawing. D, complete cleft of hard and soft palate, with double alveolar hare-lip; the vomer is distinctly seen unattached to either margin of the cleft; the os incisivum is somewhat protruded.

as a mesial one; in front of this orifice the cleft diverges outwards on one or both sides as it passes forwards to involve the alveolus. As a matter of fact, the posterior portion of the cleft is usually situated somewhat to the left of the middle line. The septum of the nose in cleft palate, descending in the mesial line, approaches, but more commonly does not become adherent to either margin of the cleft.

Frequently, however, the septum becomes attached to one of the margins of the palatal fissure (usually to that of the right side), this condition being commonly found in conjunction with left-sided unilateral alveolar hare-lip.

Symptoms.—These deformities cause much inconvenience, owing to the fact that there is free communication between the cavity of the mouth and the nasal chambers. Speech is rendered indistinct, laborious, nasal, and unpleasant. Swallowing is much interfered with, and fluids often regurgitate through the nose.

A child with a complete palatal cleft is incapable of taking the breast. Careful feeding by hand is therefore essential for the nutrition of such an infant. Several devices may be employed to meet the difficulty. The mother's milk may be drawn off by a breast-pump and administered to the child, either by means of a bottle furnished with a long broad indiarubber teat, which has a large opening, whence the milk may run slowly without any suction on the child's part, or it may be given to the infant by means of a spoon. In either case the fluid must be dropped on the posterior wall of the pharynx, the child's head being always during the administration of food thrown well backwards. Unless the greatest care be taken, the child will in all probability die from malnutrition. In few cases, therefore, is a really intelligent and conscientious nurse more required.

In many cases nature's attempt to compensate in some degree for the deformity may be noticed. The edges of the cleft are approximated during deglutition, and the posterior pharyngeal wall is drawn forwards to assist in narrowing the entrance to the nasopharynx.

Treatment of cleft palate.—It must be borne in mind that cleft palate can only prove fatal in the infant whose nutrition, owing to the difficulty of the administration of food which it occasions, is thereby endangered. In the infant the cleft is by almost all surgeons rightly deemed inoperable. In the child after the age of two years the chief importance of the malformation is the defect of speech which it occasions.

In the great majority of cases of cleft palate it is advisable to endeavour to close the cleft by suture, but in many instances it will be found necessary to repeat the operation in whole, or much more frequently in part, before a satisfactory result can be obtained. The result of the most carefully executed operation may be unfortunate; thus, after the best endeavours of the surgeon, the sutured edges may be torn asunder by vomiting after the anæsthetic, or by prolonged coughing, or for some obscure reason they may utterly fail to unite. In such a case, though sloughing of the flaps is almost never observed, it is obvious that, owing to the paring of the edges preliminary to suture, the cleft of necessity has been increased in width. It is well further to be prepared for the fact that the closure of the cleft in no way remedies the defective articulation. The fissured soft palate is always more or less deficient in other

respects. Even after a successful operation the formerly cleft, but now united, palate is still unable to act as a thoroughly efficient partition, completely shutting off communication between the mouth cavity and the naso-pharynx.

All that the operation can accomplish is to place the patient in the position of one who can be educated to articulate fairly naturally. The training to speak must always be a slow and wearisome task, but the result obtained by patient endeavour will well repay the trouble bestowed upon it.

The operation for the closure of a palatal cleft has, as will be easily understood, some slight mortality, and this fact, taken in conjunction with other considerations, among them those above-mentioned, has induced some few surgeons and more dental surgeons to dissuade patients from undergoing the operation. They maintain that a firm obturator connected to the hard palate with a flexible part for the soft palate yields in most cases a fairly satisfactory result. It is undeniable that every now and then one meets with a cleft so wide, a palatal arch so low, and palatal structures so thin and ill-developed, that it is obviously impracticable to obtain union between the edges of the fissure. This may also be the case in patients in whom operative measures have been undertaken, perhaps more than once, and have proved quite unsuccessful. In such cases the surgeon may be forced to admit that the wearing of a well-constructed obturator will be the best treatment for his patient.

Still, it must be distinctly understood that such cases form but a small fraction of all examples of cleft palate. Whenever possible, operative treatment, having for its object the complete and permanent closure of the cleft, should be undertaken. In this connection several points present themselves for consideration. Of prime importance is the question: *At what age should the operation be performed?* It may, I think, be laid down that, whilst it is never wise to operate upon a child under three years of age, the time of election is from this age up to six years. However severe and complicated the case may be, no advantage can accrue from postponing the operation longer than the sixth, or at the very outside limit, the eighth year. The vast majority of all cases should be submitted to operation between the third and sixth years of life, and it may truly be said that the shorter and narrower the cleft, the higher the arch of the palate, the more vigorous the child, the earlier may the operation be performed and the more satisfactory will be its result. Should the cleft implicate both the hard and soft palate, suture of both should be undertaken at the same time. Nothing is gained by uniting each singly at a separate sitting.

Operations for cleft palate. — Two terms in common use need explanation—*uranoplasty*, signifying the operation for closure of the cleft in the hard palate; *staphyloraphy*, denoting the uniting of the margins of the fissure of the soft palate. When the cleft involves both the hard and soft palate, *uranoplasty* and *staphyloraphy* are to be performed at the same time.

Staphyloraphy.—The patient being anæsthetised, preferably with chloroform, is placed on his back with the head dorsiflexed—i.e. over-extended. The margins of the cleft are now made tense by traction on the fissured uvula, and are pared from before backwards, so as to present two raw edges, particular care being taken to ensure the due paring of the anterior angle of the cleft. The halves of the soft palate must now be united by sutures in such a way that they may be kept in accurate apposition without undue tension, which would naturally interfere with their permanent union. In narrow clefts of small extent the sutures may be tied as soon as they are passed, and the margins brought together without causing undue tension.

In more extensive fissures, longitudinal incisions (Fig. 736) will often be required before the sutures can be tied. These incisions are to be made on each side of and parallel to the margins of the cleft, and should extend from the most anterior suture in the soft palate



Fig. 736.—Staphyloraphy. (Löbker.)

backwards as far as may be necessary, so as to lie to the inner side of the hamular process, and thus to avoid the risk of injuring the posterior palatine artery. These lateral incisions, when employed, should be made after the sutures have been passed and loosely tied, the latter can then be drawn tight, as all tension should be relieved if the incisions have been properly performed. If, however, in spite of free lateral incisions there still remains a distinct amount of tension when the sutures are tied, it is well to introduce a slender-pointed raspatory through the incision, and with it to detach the muscular and tendinous structures from the hamular process (Treves). This procedure is, in my opinion, far more satisfactory than the methods of division of the levator and tensor palati muscles recommended by Ferguson and Pollock.

Uranoplasty.—Three operative measures for closure of the cleft in the hard palate may be mentioned: (1) Langenbeck's (2) Dieffenbach's, and (3) Davies-Colley's.

(1) Langenbeck's operation is the method almost exclusively practised at the present time. In this procedure muco-periosteal flaps

are detached from the hard palate and are united by suture, tension being relieved by means of lateral incisions. It is usually advisable, when the cleft is wide, not to pare the edges, as this involves an unnecessary loss of tissues, already very spare in amount (*vide infra*).

Lateral incisions, as long as may be deemed necessary, are made on each side parallel to the cleft, and half way between it and the alveolus. Through these incisions, which must go down to the bone, a blunt curved periosteum elevator or raspator is inserted, and by its aid the mucous membrane and periosteum are peeled off the subjacent bone between the incision and the margin of the cleft. A muco-periosteal flap is thus formed on each side, free laterally, but attached anteriorly and posteriorly. The only place where this detachment presents any real difficulty is at the junction of the hard and soft palate, where the scissors are employed to cut through the attachment of the soft to the posterior margin of the hard palate. The flaps can now be readily brought together and retained by sutures.

It is always well to have the flaps sufficiently free that they even overlap somewhat when brought together in the middle line. If the margins of the cleft have not been pared this is the more necessary, as to ensure union the margins of the cleft must be everted preparatory to suturing, in order that raw surface may touch raw surface.

(2) In Dieffenbach's operation, after paring the margins of the cleft, lateral incisions are to be made as in Langenbeck's operation; into each lateral incision a chisel is inserted and made to cut through the hard palate, until it presents in the inferior meatus of the nose. Each segment of the palate included between the cleft and the incision is now prised by the chisel inwards, until the two meet in the middle line, when the freshened margins of the cleft are united by suture.

(3) Davies-Colley has described* a new method of dealing with clefts of the hard palate. A flap, somewhat triangular in shape, composed of the muco-periosteum of the wider side of the cleft palate, is dissected up in such a way as to be attached posteriorly by its base to the junction of hard and soft palate, whilst its sides and apex are free. On the other side of the palate a raw surface is prepared to receive this by elevating a muco-periosteal flap, formed by an incision crescentic in shape, and with its convexity directed towards the teeth of its own side in such a manner that it can be folded as on a hinge into the cleft, and there fixed by sutures to the opposite side. This flap presents its raw surface towards the cavity of the mouth. The first-mentioned flap is now moved across the cleft, so that its raw surface is in apposition to the similar surface of the other flap, and retained *in situ* by suture. Thus a muco-periosteal band of two thicknesses bridges across the gap with a mucous surface towards both the oral and

* *Brit. Med. Journal*, 25th Oct., 1890.

nasal chambers and the two raw surfaces applied to one another. This operation is applicable only to clefts of the hard palate, and usually leaves a foramen anteriorly. It will rarely be required, as its chief use apparently is in clefts considered too wide to bridge across by the usual method. Undoubtedly Langenbeck's operation is the one indicated in almost every case, and certainly it yields the best results.

After-treatment.—No food is to be given until all vomiting has ceased; let milk alone be given for the first three days. Talking must be forbidden. Let the mouth be washed out after each administration of food with a mild antiseptic lotion. The sutures should not be removed until the fourteenth day, or later. Interference with, and even inspection of, the wound during the first week is most inadvisable.

INJURIES OF MOUTH, PALATE, TONGUE, TONSIL, AND PHARYNX.

Injuries of these regions are frequently met with, and present certain distinctive features, owing to the great vascularity of the parts. This vascularity is a disadvantage, in so far as it tends to cause profuse hæmorrhage; it has, however, the great corresponding advantage that contused and lacerated wounds may here heal with a rapidity and certainty unknown in most other regions of the body.

Injuries of the lips.—Contusions are very common, and it is noteworthy that the bruising, ecchymosis and consequent swelling are much more apparent on the mucous aspect of the lip, owing to the fact that this more lax and tenderer surface is in these injuries forced against the teeth and jaws.

Wounds of the lip may be classified into those causing incomplete division of the structures of the lip, those completely cutting through the lip, and those accompanied by loss of substance. With regard to the two former varieties, whilst gaping of the wound will in both instances require careful approximation of the edges by suture, in the first the coronary artery will often escape division, in the second it must of necessity be divided if, as is usual, the wound be perpendicular to the margin of the lip. It must be borne in mind that the coronary artery in the lip may be severed by forcible pressure against the teeth, and give rise to profuse bleeding, without one drop of blood escaping from the mouth externally. This is often seen in drunken patients, who may thus swallow a large quantity of blood, the hæmorrhage being doubtless increased by suction of the lip. The coronary artery may be ligated, but usually careful suture of the wound suffices to arrest any further bleeding. Wounds with loss of substance are usually the result of gunshot injuries or of bites, and the resulting deformity will often require to be remedied by a plastic operation.

Burns of the lips may be caused by contact with corrosive

and caustic fluids. When situated externally, the presumption is in favour of their being due to intentional injury, such as vitriol throwing; when confined to the mucous surface they are usually the result of a suicidal attempt. Such injuries may lead to an acquired cicatricial contraction of the orifice of the mouth.

Injuries of the mouth.—The cavity of the mouth may be laid open by a wound severing the tissues from without inwards; such an injury will require accurate suturing of both skin and mucous edges. The cheek may also be penetrated from within outwards in children who fall with a toy or the end of a stick in their mouths. In two such instances I have known death from tetanus to occur. In a similar way the palate and pharynx may be injured. Burns caused by the accidental reception into the mouth of very hot fluids, such as soup, coffee, etc., are mostly trivial in nature, as the food is immediately rejected; those due to corrosive and caustic substances may cause sloughs that, being cast off, leave raw surfaces, the healing of which will give rise to marked cicatricial contraction in the cavity of the mouth.

Injuries of the tongue. Burns and scalds.—Those which are due to taking too hot food are not serious; they cause a few minutes' severe pain, a few hours' smarting and soreness, and then everything returns to the normal condition. Mel boracis and solution of chlorate of potash (3j to 3vj) are grateful applications. The really serious burns are such as are due to corrosive and caustic substances, as the caustic alkalies and mineral acids. In such cases, however, the injury to the tongue is usually remarkably slight compared with that of the fauces, pharynx, and œsophagus, the thickness of its epithelial covering markedly protecting the tongue. When, however, the tongue is severely involved, sloughing will ensue, leading to cicatricial adhesions, which seriously impair the mobility of the organ.

Scalds of the tongue and buccal mucosa are fairly commonly seen, caused especially by young children attempting to drink out of the spout of a kettle of boiling water. In these cases, that which causes the injury is not the water, of which none usually reaches the mouth, but the steam which gains entrance into the upper air-passages. The tongue may be swollen and tender for a time, but this passes off without further treatment than that mentioned above for slight burns of the tongue. The entrance of the steam into the air-passages gives rise frequently to a severe and sudden œdema of the loose submucous tissues above the glottis, the so-called œdema glottidis, which may urgently call for the performance of tracheotomy.

Stings and bites of insects—*e.g.* bees or wasps—when received by the tongue often cause rapid and serious swelling of the organ, with great pain and marked constitutional disturbance. Death, however, rarely results, though for some time the acute glossitis which rapidly ensues upon the infliction of the sting or bite appears very alarming, and threatens suffocation. The swelling usually disappears rapidly, though some induration may remain for a considerable time

The mouth may, in the case of a sting of the tongue, be washed out with a dilute solution of ammonia to counteract the poison. Should the swelling of the organ be extreme, the propriety of making longitudinal incisions into the tongue to aid depletion may be considered. Such are, however, very rarely needful. Snake-bites of the tongue are almost unknown in England, except in the case of jugglers, who take the reptiles' heads into their mouths. In the bites of non-poisonous snakes the symptoms do not differ much from those of stings above described. In the very rare instances of bite of the tongue from a venomous reptile, death rapidly ensues, owing to the free lymphatic and vascular connections of the organ.

Wounds of the tongue may be due to stabs, bullet injuries, or to falls and blows when some foreign body as a pipe-stem is in the mouth, but far more frequently they are caused by the teeth, either in epileptic or apoplectic seizures, or in those who fall or receive a blow upon the chin whilst the tongue is protruded. In such cases the protruding tip may be bitten off, but more frequently there is only partial division of the organ, which is then more injured on its under surface. The hæmorrhage is often very severe, and death has occurred in rare cases from this cause. In the great majority of cases, however, it is remarkable how quickly the injury is recovered from, and how little deformity results.

The chief *complications* of severe wounds of the tongue are hæmorrhage, conditions such as septic pneumonia, the result of a septic wound in the mouth, and cicatricial adhesions. It is well here to discuss briefly the question of *hæmorrhage from the tongue*. The first indication is to arrest it. If, as is usual, the wound be near the tip, this is an easy matter, the bleeding vessel being seen without difficulty, and, if necessary, ligated in the wound. Quite otherwise may be the condition when the bleeding vessel is far back in the tongue. In such a case an anæsthetic should be given, the tongue be drawn well out of the mouth, the wound being enlarged, if necessary, in order to see clearly the bleeding vessel. If this be an artery it must be ligatured *in situ*; if the hæmorrhage be merely venous, closing the wound firmly by suture will usually suffice to arrest further bleeding. A good light and thorough removal of all clots are of great importance in this searching for the source of the hæmorrhage.

Secondary hæmorrhage from the tongue is fortunately rare (except in cases of foreign bodies in the organ). It is a very serious complication. In such cases the bleeding point may not be discoverable in the sloughing state of the wound, and even if found the vessel may be too much softened to bear a ligature. When such is the case, ligation of the lingual artery in the neck will be the safer course to pursue. If, as may happen in gunshot wounds involving the tongue, tonsil, palate, and neighbouring parts, there be great doubt as to the source of the hæmorrhage, and the patient be exhausted by one or more attacks of secondary hæmorrhage, it will be wise to ligature the external or, if it is thought possible that the

trunk of the internal carotid may be injured, the common carotid artery.

Treatment of wounds of the tongue.—After arrest of hæmorrhage, sutures of thick horsehair or of silkworm gut may be employed to unite the divided surfaces, and a weak antiseptic solution may be used as a mouth wash. Ice may be sucked, and in cases with much laceration iodoform may be dusted on. Wounds of this part heal with remarkable certainty.

Among foreign bodies in the tongue may be mentioned bullets, teeth, broken pieces of jaw the result of gunshot injuries, broken pieces of clay pipe-stems, broken fragments of teeth the result of attempts at extraction of teeth, fish bones, etc. When the history of the case suggests the lodgment of a foreign body in the tongue, a most careful search should be made for it. It may, it is well to remember, be deeply embedded in the substance of the organ, and not at first discoverable. If, however, the wound refuse to heal, and more particularly if secondary hæmorrhage occur, no time should be lost in making a second and more thorough examination under anæsthesia. Sometimes an inflammatory induration surrounds the foreign body, down to which a sinus leads, or acute inflammation, ending in suppuration, may occur. In rare cases a foreign body has remained encapsulated in the tongue for years, but this is a most exceptional circumstance. The rule of practice always to be followed is immediate removal of the foreign body, when the wound will at once commence to heal. Severe hæmorrhage may ensue on the removal of the offending substance, and for this emergency the surgeon must be prepared.

Injuries to the palate.—Much that has been said above with reference to injuries of mouth and tongue from corrosive and caustic fluids, gunshot injuries, etc., applies with equal force to the palate, tonsil, and pharynx. Injuries of the *hard palate*, when severe, are usually due to gunshot wounds, generally of suicidal intent. In such cases other parts—*e.g.* the nose and pharynx—will be involved in addition. Should the wound not be fatal it will leave a large perforation in the hard palate. To obviate this as far as possible, every portion of bone and mucous membrane not entirely detached from the hard palate must be replaced and sutured into position. In such cases a remarkable amount of success will often attend the surgeon's efforts, especially if an antiseptic mouth wash be freely used, which will much diminish the tendency to the development of septic periostitis and necrosis of the palate.

The *soft palate* may be wounded by punctures from fish bones or splinters of bone taken in the bolus of food. These bones may stick in the palate and cause much discomfort; their removal is, however, a very easy matter, and is usually accomplished by the patient. In certain cases a localised blood extravasation (*hæmatoma*) of the palate may thus be caused; more rarely abscess may ensue. Small punctured wounds of the palate heal without deformity, but larger wounds penetrating the whole thickness of the palate, owing to their tendency

to gape, require careful suturing. Wounds involving the free margin of the palate must be most accurately brought together by suture; they have no tendency to unite spontaneously, and unless carefully treated, gape, giving an appearance resembling that of partial cleft of the soft palate.

Injuries to the tonsil.—These are rare. Severe hæmorrhage has followed punctured wounds in this region, and there always exists the doubt as to whether the blood comes from the internal carotid or the ascending pharyngeal artery. A case related by Mr. Morratt Baker well exemplifies this difficulty. A man fell whilst drunk, and injured his throat with the stem of a pipe which he had in his mouth at the time. He thought little of his accident for a while. Two days later he came to the hospital with what appeared to be an acutely inflamed tonsil. This was punctured, nothing but a little blood escaping. Severe hæmorrhage occurred from the tonsil wound, and on the fourth day after the injury one inch of the stem of a clay pipe was discovered deeply embedded in the substance of the gland. It was removed, and the common carotid artery was ligatured. The patient, however, never rallied from the previous severe hæmorrhages, and soon died. The autopsy showed that the portion of the stem of the pipe, which had not been missed by the patient, had divided the ascending pharyngeal artery.*

Instances of damage to the internal carotid, giving rise to profuse hæmorrhage, have been described as occurring after removal of the tonsil by the vulsellum and bistoury, and also after a similar operation performed by using the galvano-caustic snare. Such an accident as the first mentioned could only occur if the blade of the knife were directed outwards, but it is conceivable that the vessel might be injured by its proximity to the intensely heated wire in the latter case. When the surgeon can be certain that the vessel injured is the ascending pharyngeal, then, after pressure has been applied and has failed to arrest the hæmorrhage, the external carotid artery should be ligatured. When there is any doubt on the subject ligature of the common carotid should be performed. These remarks are not intended to apply to hæmorrhage after tonsillotomy, which, except in the subjects of hæmophilia, can almost always, even in the most severe instances, be arrested by forcipressure; one blade of a long forceps, ensheathed in lint, being applied to the cut surface of the tonsil, the other blade being situated on the cutaneous surface just behind the angle of the jaw.

Injuries to the pharynx are not so infrequent as might be imagined. They are due chiefly to gunshot wounds, falls with a pipe, stick, pencil, or toy in the mouth. Severe hæmorrhage—for which the surgeon should be prepared—may occur upon the withdrawal of the portion of the injuring body impacted in the wound, especially when it has perforated the side walls of the pharynx. If the bleeding vessel can be seen it should be ligated; if it cannot be found, pressure

* St. Bartholomew's Hospital Reports, 1876.

upon the bleeding point, or the application of the galvano-cautery at a dull red heat must be employed to arrest the hæmorrhage. In very severe cases, especially of secondary hæmorrhage, the ligature of the external or common carotid artery may be called for. Scalds from inhaling steam from the spout of a kettle have been described under "Injuries to the Tongue" (page 469), where attention has been drawn to the fact that œdematous laryngitis, the so-called œdema glottidis, is apt to follow such accidents. This may also result from the involvement of the tissues of the pharynx in cases of swallowing corrosive fluids. In such conditions the pharynx usually suffers severely, and even if recovery ensue, there is frequently left much cicatricial contraction of pharynx and œsophagus.

Foreign bodies in the pharynx are most commonly substances which have been taken into the mouth as food; thus, large fragments of bread (especially crust) and lumps of meat without due mastication are very apt, when swallowed by gluttonous persons, to be arrested in the lower part of the pharynx—i.e. over the upper opening of the larynx—which is thus blocked, and entrance of air into the air-passage is prevented. This gives rise to the most urgent symptoms of asphyxia, and demands instant relief by removal of the foreign body; or, if this be impossible owing to it being firmly impacted, tracheotomy or laryngotomy must be done instantly, preferably the latter, owing to the greater rapidity with which it can be performed. Deaths from this impaction of hastily-swallowed food are by no means infrequent. Other foreign bodies which may be found impacted in the pharynx are tooth-plates, coins, and portions of bone. The commonest situation for the lodgment of these larger bodies is about the level of the cricoid cartilage. They can be usually felt, and often removed by the finger passed well down the pharynx. Should this not succeed, various kinds of forceps may be employed, with the aid of the laryngoscope. Small fish bones, pins, etc., are apt to stick in the tonsils, pillars of the fauces, and more particularly in the loose folds of mucous membrane of the pharynx behind the posterior faucial pillar; sometimes they lie transversely across the cavity. They can usually be seen, and can be removed with forceps. It is worthy of mention that for some time after the removal of such an object the patient may feel abnormal sensations, due to the injury (puncture or scratching) of the mucous membrane, and may be persuaded only with the greatest difficulty that the offending body has in reality been removed. A little cocaine applied to the part will usually aid in convincing him. In cases in which a large and jagged tooth-plate has become firmly impacted low down in the pharynx, whence it cannot be drawn up into the mouth, pharyngotomy may be required, in order that the plate may be removed through the opening in the neck. This, however, is a rare contingency.

AFFECTIONS OF THE LIPS.

Hypertrophy may occur in either lip. It is most frequently seen in tuberculous children, hence the term *Strumous Lip*. Often it is apparently due to a slight chronic inflammatory process, the result of the oft-repeated irritation from cracks and fissures of the lip. In such cases, when seen before growth of new fibrous tissue in the lip has taken place, the oedematous swelling may be cured by the removal of the source of irritation, by healing the fissures and cracks, by appropriate treatment. In other cases the enlargement is permanent, and continues, in spite of the administration of the usual remedies—tonics and cod-liver oil—which have a beneficial effect in the earlier stage. This condition must be distinguished from *macrocheilia*, or *lymphangioma cavernosum* of the lip.

Macrocheilia (*μακρός*, great; *χείλος*, the lip).—This term is applied to a rare condition, in which the lips are greatly increased in size, the enlargement being very generally congenital, though sometimes acquired. Either the upper or lower lip, or both, may be affected.

Several factors take part in the causation of this enlargement, which is often considerable. There is diffuse hyperplasia of the connective tissue, and increase both in number and size of the blood-vessels, and also far more importantly of the lymphatic vessels and spaces (*lymphangioma cavernosum*). The more the blood-vessels are involved, the softer is the growth; the more (as is usual) the lymphangiectatic element predominates, the firmer will be the enlargement. When the lower lip is affected it becomes, by its own weight, everted and depressed. The commoner congenital form is declared by some to owe its origin to an abnormal development of the first branchial arch, in support of which statement it is said that the jaw bones may be found correspondingly enlarged and malformed.

The *treatment* of this condition is unsatisfactory. The usual method is to remove a wedge-shaped piece of the lip, and then to unite the cut margins. Electrolysis and multiple puncture with the galvano-cautery may also be employed.

Herpes of the lip is frequently seen in febrile attacks. It is characterised by painful swelling of the lip, followed quickly by a vesicular eruption. The vesicles, usually serous, are surrounded by a red inflammatory zone, and may become purulent. Within a week the vesicles dry up, scabs form, and are soon cast off. It may here be mentioned that when herpes occurs on a mucous surface—as of the lips, or more frequently on the hard palate—the vesicles are rarely observable, as the epithelium is macerated, and soon shed, and thus superficial excoriations result.

Superficial ulcers on the mucous surface of the lip are common accompaniments of disordered digestion. They are often found in association with similar ulcers on the mucous surface of the

cheek or tongue. They may be touched with a pencil of nitrate of silver, and attention must be directed to the digestive functions, otherwise successive crops of ulcers are prone to make their appearance.

Cracks and fissures of the lip are common in cold weather; these so-called chapped lips are often very painful, and bleed freely on slight handling. There is often a somewhat deep fissure in the median line of the lower lip. Generally such cracks can be cured by the application of some simple unguent, or, if this does not suffice, they may be touched with nitrate of silver. Very rarely an extensive fissure of the lower lip may call for excision of its indurated and painful margins. It has already been mentioned that cracks and fissures in strumous children may give rise to hypertrophy of the lip. They may also lead to enlargement of the lymphatic glands in their neighbourhood.

In children suffering from congenital syphilis, fissures at the angles of the mouth are very commonly seen. These leave cicatrices, which persist throughout life, are readily recognisable, and form a valuable guide to the diagnosis in after-life of congenital syphilis.

Transient painless œdema of the lip is a curious condition which is not unfrequently seen. There is rapid enlargement and marked œdema of this very distensible part; it follows no injury, has no discoverable cause, is unaffected by treatment, occasions no alteration in the colour of the lip, and disappears in the course of a few days, leaving no trace behind it. Of prime importance as regards its diagnosis is the fact that, in spite of its formidable appearance, pulse and temperature are alike unaffected.

Furuncles of the lip are frequently met with. They cause much inflammatory swelling, and when the upper lip is involved the œdema tends to spread to the loose tissues of the lower eyelid.

The treatment differs in no respect from that of furunculosis elsewhere situated.

Carbuncle of the lip is always a formidable condition, and not infrequently causes death. It has been stated on high authority that it is always fatal; this, however, is assuredly an exaggeration, and there is little doubt that the statement was made owing to the fact that malignant pustule has been in many cases mistaken for carbuncle when occurring on the lip. These two diseases are in their early stages certainly not easy to differentiate. In carbuncle there is inflammatory induration of the lip (usually the upper lip), which is swollen and painful; the temperature is markedly elevated, and there is considerable constitutional disturbance. Soon the indurated area becomes red and elevated above the surrounding surface, and small openings, giving exit to yellow heads of pus, are seen; the lip, ala of nose, the cheek, and lower eyelid are involved in the inflammatory œdema. The skin then gives way, and the large slough, laden with pyogenic cocci, is extruded. After the expulsion of the slough the healing process in favourable cases rapidly sets in, and in the course of a few days appearances are returning to the normal.

Unfortunately, however, in many cases infective thrombo-

phlebitis of the veins of the part occurs, which, spreading from the rootlets of the facial vein to those of the ophthalmic veins (the free intercommunications between these veins near the inner angle of the eye is well known), thence involves the intra-cranial blood sinuses, and gives rise to septic meningitis, septicæmia, or pyæmia.

The *treatment* of carbuncle of the lip—especially of the upper lip—must be energetic and thorough. Deep incisions will render possible the early removal of the sloughs; interstitial injections of carbolic acid solution (1 to 30) may be made into the indurated periphery of the swelling, and compresses soaked in 1 to 3,000 corrosive sublimate solution may be applied to the lip and frequently changed. Stimulants, quinine, iron, and strychnine may be freely administered to combat the great prostration often observed in severe cases.

Malignant pustule or charbon may occur on the lip, and in its earlier stages may be confounded, as above stated, with carbuncle. It may be observed that the morbid process in this condition affects the tissues of the part from without inwards. The reverse is the case in carbuncle.

The diagnosis and treatment of malignant pustule, wherever situated, are dealt with elsewhere (p. 311, Vol. I.).

Angiomata or nævi are very frequently met with, situated on the margin of the lip, whence—when of any size—they may hang pendulous, and are then often removable by a ligature. When the whole thickness of the lip is involved the tumour, if small, may be excised, and the cut surfaces of the lip united by suture; if large and affecting the greater portion of the lip, electrolysis or multiple galvano-puncture will be the appropriate treatment.

Cystic tumours of the lip are most frequent on the lower lip. They are retention cysts of the mucous glands, which are so abundant in the buccal submucosa. These little tumours, rarely exceeding the size of a cherry, present themselves as smooth, tense, translucent, fluctuating swellings, covered only by the stretched, and therefore thinned, mucous membrane, and contain a glairy mucinous fluid. Incision alone does not suffice, as recurrence is the rule after simple incision and evacuation of the contents. Complete excision of the cyst should be the method employed. The frequently recommended procedure of incision, followed by painting the interior of the cyst wall with caustics, is not to be adopted, being more painful and far less certain in its results than the more radical measure of excision.

Papillomata or warty growths are common on the lip, and may, if irritated, take on epitheliomatous growth. Their epithelium may become much hypertrophied, giving rise to distinct horny growths. These tumours call for removal by excision.

Adenomata or labial glandular tumours have their origin in the sebaceous, or possibly in the sweat glands of the lip (usually of the lower lip). They may attain to the size of a walnut; they appear as smooth elastic tumours, covered only by mucous membrane, after incision of which they may readily be enucleated.

Tuberculosis of the lip presents itself in two forms, that commonly seen being ordinary lupus; very rarely do we meet with a distinct tuberculous ulcer of the lip resembling the more definitely recognised tuberculous ulceration of the tongue.

Syphilitic lesions of the lips are common, and may be seen as primary, secondary, or tertiary manifestations of the acquired form, or they may be symptoms of the congenital type of the disease.

Chancre of the lip is one of the most frequent of extra-genital chancres. It may be due to direct inoculation from contact with a chancre or mucous plaque, as occurs in kissing; or the virus may be conveyed by the use of cups, glasses, pipes, etc.; or in infants by sucking the nipple of a syphilitic wet nurse. Lip chancres are usually single, and though typical indurated Hunterian chancres are frequently seen, it must be borne in mind that induration is not seldom entirely absent, and that such chancres often present appearances very unlike those which we see on the genital organs. Chancroids (non-infective soft sores) are practically unknown on the lip. A most important point is the differential diagnosis of chancre from cancer of the lip; this will, however, be dealt with after the latter condition has been described.

The *treatment* of chancre of the lip differs in no particular from that of chancres in other parts of the body. It need only be mentioned that, owing to the position of a labial chancre exposing it to irritation in the taking of food, movements of lip, etc., ulceration is very prone to occur, and the chancre itself tends to remain longer than when situated on parts less subject to unfavourable external influences.

Mucous plaques are very commonly met with on the lips of patients suffering from secondary syphilis. They may be looked upon as part of the general eruption, involving the mucous membrane in place of the skin. They are virulently infective.

Tertiary syphilitic disease of the lip is rare; it may occur either as a diffuse thickening of the part, or in the form of a circumscribed gumma.

The cracks and fissures at the angle of the mouth, so commonly seen in children the subjects of congenital syphilis, have been already alluded to when treating of cracks and fissures of the lip.

Epithelioma of the lip (Figs. 737, 738) is unfortunately very common. It is well known that epithelioma is frequently met with in situations (as the lip) where skin and mucous membrane meet. It almost constantly occurs on the lower lip, and in male subjects who are smokers and over forty years of age. Labial epithelioma is very rare in women, on the upper lip in either sex, and in patients under thirty years of age.

Symptoms. It is always a squamous-celled epithelioma, and may commence as a warty growth, an ulcer, a crack or fissure, or as a small indurated callous nodule. However it may make its first appearance, it shows no tendency towards healing, but, on the

contrary, tends to spread superficially or deeply, or more commonly in both directions, into the tissues of the lip. Ulceration occurs early, and though frequently a firm scab may appear on the surface, this, when removed, reveals the presence of a subjacent ulcer. The characteristic epitheliomatous ulcer soon develops with its raised everted indurated margins and ragged sloughy base. The ulcerative process



Fig. 737.—Slow-growing Epithelioma of the Lip. (From a patient at the London Hospital.)

once started extends steadily and surely, and the neoplasm (unless removed by operative treatment) implicates the whole of the lip, becomes adherent to and then infiltrates the lower jaw, infects secondarily the lymphatic glands in the submaxillary region, and later those behind the angle of the jaw and along the line of the great vessels of the neck. It is a noticeable fact that, as pointed out by Broca and others, this form of cancer occupies a position, in respect of malignancy, intermediate between rodent ulcer of the face and epithelioma of the tongue—being less benign than the former, and less malignant than the latter. Although the local appearances

may indicate very extensive ulceration and advanced implication of the neighbouring glands, still secondary deposits in the viscera are rarely seen. The growth is certainly more malignant in younger and more vigorous florid patients than in aged, spare, anæmic individuals, in whom extension of the disease progresses more slowly.

The infected glands increase rapidly in size; they tend to become adherent to the carotid sheath, and may press upon the internal jugular vein, the œsophagus, or the trachea. Such glands very frequently break down in the centre, forming fluctuating irregular bossy swellings which give to the examining fingers somewhat the feel



Fig. 738.—Epithelioma of the Lip of very rapid Growth. (From a patient at the London Hospital.)

of a multilocular cystic tumour, and contain hæmorrhagic *débris*. The large glandular mass in the neck causes, by involvement of the superjacent tissues, destruction of the overlying skin, which gives way and exposes to view the sloughy foul cavity with its broken down soft hæmorrhagic contents. Repeated hæmorrhages now occur which, aided by the septic poisons absorbed from the growth, exhaust the patient, or a sudden profuse hæmorrhage from extension of the ulceration to the carotid artery or jugular vein may prove rapidly fatal. Death may, in other cases, be due to septic pneumonia or to pressure upon the air-passage or the gullet. The average duration of life in cases not submitted to operation is about eighteen months. König gives one to four years as the extreme limits.

Treatment.—Excise the growth freely and as early as possible after a definite diagnosis has been made. The removal is generally

performed by including the neoplasm in a V-shaped incision. Care must be taken to cut wide of the growth through sound tissues. It is wise to keep the incision everywhere fully $\frac{1}{4}$ inch at least from the periphery of the growth, to ensure cutting through sound tissues. It cannot be too strongly impressed upon the surgeon that the ultimate prognosis depends, in great measure, upon the absence or presence of glandular implication.

The **prognosis** in epithelioma of the lip is for a cancer, comparatively speaking, favourable; this is due no doubt to the early stage in which the condition is usually recognised and is the result of its exposed position on the lip. When the neoplasm is removed before glandular involvement has occurred, there is a fair prospect of permanent freedom from recurrence.

Very different is the case when the glands have become distinctly infiltrated with new growth. In such cases recurrence in neighbouring glands is the rule, though excellent results may follow free extirpation of the epithelioma and infected glands. When the glands along the great vessels of the neck are extensively involved, it is a question whether operative interference is justifiable. The chance of totally eradicating the disease is practically nil, and the common occurrence of infiltration of the great vessels may necessitate serious measures, such as removal of portions of the carotid sheath or artery, or of the jugular vein. Should the vagus nerve be implicated the condition is, of course, clearly inoperable. It is rarely good surgery to interfere with malignant glands beneath the sterno-mastoid muscle. Good results can only be obtained by early operation; there must, therefore, be no delay, no waiting for glandular infection to settle the diagnosis. Microscopical examinations of scrapings from the growth, or of an excised portion will give proof of its malignant nature, and, as soon as this point is settled, operative procedures must be at once undertaken. I would wish to warn the surgeon that here early glandular implication is often overlooked. Several times have I, after division of the deep cervical fascia, felt glands distinctly involved, which, when palpated through the unbroken skin, manifested no sign of enlargement. It is, I am convinced, in all cases of epithelioma of the lip which have gone on to ulceration, the part of wisdom to remove, at the time of operation on the lip, the nearest set of lymphatic glands, whether they be felt to be enlarged or not. When the epithelioma lies exactly in the middle line of the lower lip, the glands to be excised are those situated between the two anterior bellies of the digastric muscles (supra-hyoid glands); should, however, the growth be situated more laterally, the glands in the submaxillary region must be removed, and along with them extirpation of the submaxillary gland itself is strongly to be recommended. In all cases of mammary cancer it is the rule to remove the nearest set of lymphatic glands, whether they can be felt to be enlarged or not, and this rule is no less applicable to cancer occurring in the lip, tongue, or any other region where the glands can be readily removed without endangering the life of the patient.

When this precept is thoroughly carried out, the prognosis of epithelioma of the lip will be considerably improved. In cases accompanied by extensive ulceration, a plastic operation will often be required to remedy the defect caused by the free removal of the disease. In such a case the surgeon's first endeavour must be to remove the entire disease, after which he may exercise his ingenuity in reducing to a minimum the necessarily resulting deformity.

Diagnosis.—The following table may prove of assistance in the differential diagnosis of chancre and epithelioma of the lip :—

CHANCRE	EPITHELIOMA
Occurs at any age.	Occurs after forty years of age.
More frequently in females.	Almost invariably in males.
Rather more frequently on upper lip.	Almost invariably on lower lip.
Painless.	Often lancinating pain.
Regularly outlined smooth elevation, if seen before ulceration has commenced.	Irregularly outlined ragged prominence or ulcer, with everted edges.
Induration (if present) distinctly circumscribed.	Induration not uniform, varies in different parts, and is more diffuse.
Induration precedes ulceration.	Induration follows ulceration.
Develops in days or weeks.	May be months in developing.
Implication of a number of glands simultaneously within a short time of appearance of chancre.	Glands implicated one by one months after appearance of epithelioma.
No perceptible smell.	Smell often offensive.
Secondary syphilides — <i>e.g.</i> roscola, plaques, etc.	None.
History of exposure to syphilis.	None.
Slight elevation of temperature common.	Temperature normal.
Yields readily to mercury.	Unchanged for better by mercury.

AFFECTIONS OF THE MOUTH.

Stomatitis.—Stomatitis, or inflammation of the mucous membrane of the mouth, is frequently encountered. Several varieties of this condition may be recognised. Stomatitis may be classified according to the degree of inflammation present, thus we may speak of catarrhal, ulcerative, or gangrenous stomatitis; or the classification may be based on the ætiology of the condition, thus we may describe syphilitic, mercurial, and scorbutic stomatitis. No classification as yet introduced is free from many imperfections. I prefer to base the classification on the foundation of morbid anatomy rather than of ætiology.

Five forms of the affection may be enumerated—catarrhal, ulcerative, aphthous, parasitic (thrush), and gangrenous.

Gangrenous stomatitis, or cancrum oris (noma), is dealt with in the article on Gangrene; it need not, therefore, be further referred to here. (*See* p. 150, Vol. I.)

Catarrhal stomatitis is an inflammation of the mucous membrane of the mouth, which may be caused by mechanical injury—as, for example, by sharp edges of stumps or rough carious teeth, by chemical substances, as acids, alkalies, and other irritants such as raw spirits, tobacco smoke, hot-spiced dishes, etc. The condition known as *mercurial stomatitis* should be included in this group, for whether it occur in the acute or in the far more common chronic form of mercurial poisoning, the inflammation is due to the excretion by the mucous membrane of the mouth of particles of mercury. Mercurial stomatitis commences thus as a catarrhal inflammation, but frequently passes into the ulcerative type.

Catarrhal stomatitis frequently occurs in children during the eruption of the teeth, commonly between the seventh and twenty-fourth month of life.

This form of stomatitis is often the result of an inflammation which has spread by direct continuity from neighbouring cavities, especially the nose, naso-pharynx, or pharynx.

Frequently stomatitis is a symptom of a general infectious disorder—the so-called *syphilitic stomatitis* belongs to this group. In any long-continued exhausting illness, in which care is not taken to ensure the due cleansing of the cavity of the mouth, the decomposition of particles of food, milk, etc., remaining in the mouth, and the growth of fungi may, in the weakened condition of the patient, suffice to cause an attack of stomatitis.

The *symptoms* are those of a catarrhal inflammation of a mucous membrane: thus there is redness, heat, swelling, and increased secretion, which is of a viscid tenacious nature; there is also salivation. The swollen mucous surfaces of the cheeks and of the tongue are pressed against the teeth, and the latter leave upon them their impress in the form of indentations. In severe cases the exudation may be purulent. Whitish patches caused by thickening of the epithelium may be seen on the mucous membrane; also small vesicles, which, bursting, give rise to small superficial erosions. There is a burning pain in the mouth, nasty taste, and foul breath, and, by reason of the above, naturally there is a disinclination to take food.

The duration of the condition varies according to its severity; the acute form above described may pass into the chronic stage, especially in habitual drinkers and smokers, and in those whose teeth are carious and neglected.

Two varieties of stomatitis, which are here included under the head of catarrhal inflammation of the mouth, are often described as distinct diseases; they are syphilitic and mercurial stomatitis.

Syphilitic stomatitis is one of the most manifest of the symptoms of secondary syphilis. Accompanying the cutaneous eruption is, in almost all cases, to be observed a general catarrhal inflammation of the mucous membrane of the mouth and fauces (the so-called sore throat); slightly later, mucous plaques are to be seen, which are whitish small patches, due to thickening and degeneration of the epithelium. It will be noticed that, as regards its morbid anatomy,

syphilitic stomatitis does not differ from the catarrhal form, under which it is, therefore, here included.

Mercurial stomatitis has been already briefly alluded to. It presents in slight cases symptoms identical with those of catarrhal inflammation, though in severe cases ulceration and even gangrene may occur. It is due to the too free use of mercury as a drug, to some idiosyncrasy on the part of the patient to the medicine, or to mercurial poisoning in those whose work brings them in contact with the metal. It has not infrequently been seen as the result of too vigorous washing out of a compound fracture or foul cavity with a strong solution of perchloride of mercury. In severe cases there are found profuse salivation, loosening of the teeth, fætor of breath, sponginess of the gums, swelling of the tongue, and the inflammation may go on to ulceration, or even destruction of the affected soft parts. The ulcers are usually only shallow, but sometimes they penetrate deeply into the tongue. They are covered by sloughs, which persist for a considerable time. Similar ulcers are found on gums, cheeks, and lips. The disease is seldom serious, though painful and most distressing to the patient. Under treatment abatement of the symptoms can be confidently expected in a few days, and complete recovery in from one to two weeks. It cannot be too forcibly impressed upon patients taking mercury that it is essential that the mouth be kept cleansed with scrupulous care during the administration of the drug, for no fact is more clearly demonstrated than this, that in cases where the mouth is sweet and clean, the patient can take with impunity a dose which, were the mouth foul and the teeth decayed, would give rise to a violent attack of mercurial stomatitis. Prevention is clearly better than cure, and it is an excellent rule to insist upon a patient with early syphilis having his teeth attended to by a dental surgeon before entering on his course of mercurial treatment.

Treatment of catarrhal stomatitis.—Fluid nourishment can alone be taken, as milk, custard, broth, etc.; it may be administered either gently warmed or quite cold, the former being, as a rule, more pleasant to the patient. The great indication is to disinfect and keep clean the cavity of the mouth, to which end a solution of boric acid (3j to 3vj), carbolic acid (1 to 200), or, better, chlorate of potash (3j to 3vj) may be frequently employed as a mouth wash. Any ulcer may be touched with a pencil of nitrate of silver. In chronic cases an endeavour must be made to discover and remove the factor which causes the prolongation of the trouble; further, the inflamed surface may be painted with a solution of nitrate of silver (gr. x to 3j).

In syphilitic stomatitis treatment must be directed to the general as well as the local condition. Mercurial stomatitis must be met by adopting the local treatment recommended for acute catarrhal stomatitis, by ceasing the administration of the drug, by the free employment of aperients, and in severe cases of stimulants, and, when the pain demands it, by the administration of opium.

Ulcerative stomatitis, or putrid sore mouth, is a more serious affection than the catarrhal form. In truth, in many cases it is a further development of the latter. It is a severe inflammation of the mucous membrane of the mouth, which here and there becomes destroyed, leaving superficial ulcers. It may be due to several different causes. The disease may commence primarily as an ulcerative process, in which case it is probably more or less infectious, and has been observed to occur in epidemics, especially where people are crowded together under bad hygienic conditions, as in jails, camps, and in the hovels of the poor. More frequently it is secondary to catarrhal inflammation, as is seen in severe cases of stomatitis due to the irritation caused by the eruption of teeth in children, and in most marked cases of mercurial stomatitis.

The ulcers commence usually on the margin of the gums—especially of the lower jaw—whence they spread to the lip, cheek, and tongue; seldom do they distinctly involve the palate. The mucous membrane presents dirty greyish sloughs, the gums are swollen, congested, and bleed on the slightest touch, the breath is very foul, the teeth loosen, and necrosis of the alveolar margin of the jaw bone may occur, the lymphatic glands in the submaxillary region are usually swollen and tender, and profuse salivation is present.

The local symptoms are an exaggeration of those found in catarrhal stomatitis; the taking of food is almost impossible, and the constitutional disturbance is great, the patient being usually much exhausted. The temperature is generally somewhat elevated, and symptoms of septic intoxication may be seen in the worst cases, which may in the case of debilitated children prove fatal.

The *prognosis* is favourable in the vast majority of cases. Under careful treatment the ulcers heal within a fortnight; only those cases are apt to persist in a chronic condition in which, owing to the virulence of the inflammatory process, the ulceration has extended more deeply, and has caused necrosis of the bone. It is needless to mention that healing of these ulcers is not to be expected until after such sequestra have exfoliated.

Treatment is identical with that recommended for catarrhal stomatitis, but even greater care must here be taken thoroughly to cleanse the mouth. The internal administration of chlorate of potash is almost a specific, and may be given in doses of 7 to 10 grains four times daily to a child with the happiest results. I can strongly recommend the application to the sloughy ulcerated surface of a solution of iodine in glycerine (2 per cent.). This may cause some pain at the time of application, but the ulcers under its use rapidly assume a healing appearance. Stimulants will be needed in cases accompanied by much depression, and during the stage of convalescence tonics containing iron, quinine, and strychnine are to be recommended.

Aphthous stomatitis.—This term has been very loosely applied to a number of different conditions. It is the custom with

many to call any condition in which whitish spots are found in the buccal mucosa aphthous; we must, however, distinguish between aphthous stomatitis and parasitic stomatitis or thrush.

True aphthous stomatitis, which may occur as an independent disease, or in conjunction with any of the febrile diseases of childhood, presents whitish or greyish-white slightly-raised spots or vesicles on the mucous membrane of the tongue, frænum linguae, cheeks, and lips, which are surrounded by an inflammatory zone, and may or may not be confluent. These are accompanied by more or less general inflammation of the mucous membrane. These whitish spots or vesicles are due to thickening and degeneration of the epithelium, and in severe cases to fibrinous exudation into the superficial layers of the mucosa. By the shedding of this epithelium small erosions or ulcers will be caused. This condition may occur in infancy, childhood, or adult life. The period of the first dentition is that in which it is most frequently met with. When occurring in adult life, the disease is far less amenable to treatment and far more apt to recur. What is probably the slightest form of aphthous stomatitis is a condition frequently to be seen in very young infants, consisting of symmetrical white patches (due to thickening of the epithelium) lying on the hinder part of the hard palate, near to the alveolar border. These are, perhaps, due to pressure of the tongue in sucking; they require no treatment, and disappear leaving no trace.

Treatment.—In the typical cases occurring in young children simple treatment always suffices to effect a cure. Cleanliness is of prime importance, the mouth being frequently washed out with a solution of chlorate of potash; glycerine of borax may also be employed. Much difficulty may be met with in treating the recurrent form often found in adults. On the whole, cauterisation of the little ulcers, which in adults are almost always present, by nitrate of silver, with the treatment indicated above, will be found in most instances beneficial; but in some cases caustics seem to do more harm than good.

In all cases it is well to inquire into the state of the digestive organs, and frequently the administration of small doses of rhubarb and soda will be of marked benefit.

Concerning the causation of this disease we know little that is definite. Its occasional appearance as an epidemic among children has given rise to the opinion held by many that it is due to some infection conveyed by the milk of diseased cows. The symptoms of a somewhat severe case resemble those of infection of foot and mouth disease from cattle to man.

Parasitic stomatitis or thrush.—This is a condition which may occur in children or in adults. In the latter it is only seen in conditions of great exhaustion after prolonged illness, such as typhoid, advanced phthisis, and in the last stage of malignant disease. It is, therefore, to be looked upon in adults as of serious omen. In children it is most frequently seen in wasting bottle-fed babies, in which cases

prognosis is bad. It may, however, occur in healthy infants, often through infection, which can be distinctly traced.

The disease, which commonly commences on the tongue, presents itself in the form of greyish-white spots on the mucous membrane of the mouth, which when microscopically examined are seen to be composed of a forest of mycelial threads and numerous oval spores. The fungus is the *oidium albicans*, or the *saccharomyces albicans* which belongs to the group of yeast fungi.

The growth of this parasite starts in the middle layers of the epithelium of the mucous membrane, from which level it extends both towards the surface and more deeply. Consequently, the more superficial layers can be readily and usually quite painlessly peeled off. This constitutes a point of much importance in the differential diagnosis of thrush and aphthous stomatitis, for in the latter removal of the whitish patch is impossible, and if attempted causes pain and hæmorrhage. The whitish-grey patches of thrush, generally confined to the mouth and fauces, may extend to the pharynx and œsophagus. It is a curious and noteworthy fact that the fungus seems only to be capable of growing on a mucous surface covered by stratified squamous epithelium. It is never met with on a surface covered by columnar epithelium, and therefore the nasal passages, trachea, stomach, and intestinal canal are exempt from its invasion.

With thrush a general stomatitis is always found. It is doubtful whether the latter is caused by the former or whether the inflammation of the mucous membrane is a necessary preliminary to the growth of the fungus; probably, however, the latter is the case. It may be remarked that the reaction of the secretion of the mouth in thrush is acid, in health alkaline. In thrush the mouth commonly is drier than normal, in marked contradistinction to the salivation always observed in aphthous stomatitis. The condition of the mucous membrane naturally causes the taking of food to be difficult and painful; this aggravates the previous malnutrition of the patient.

Treatment.—In healthy children an attack of thrush is a comparatively trivial affection. Cleansing the mouth frequently with any alkaline mouth wash—as lime water or with a solution of chlorate of potash (3j to 3vj), or of boric acid (3j to 3vj), or carbolic acid (1 to 200) will suffice to check the morbid condition in a few days. No form of sugar should be given, as a solution of this substance forms an excellent food for the fungus; hence it will be seen that the common remedy for this condition, honey and borax, is inappropriate.

In weakly infants and in adults in the last stages of exhaustion treatment usually fails to arrest the further growth of the fungus.

Tumours of the floor of the mouth.—Tumours other than cystic are not frequent in the floor of the mouth. *Epithelioma* is the most common, and when occurring in this region, grows usually with much rapidity, owing, no doubt, to the vascularity of the part. Its prognosis here is therefore more than usually bad, and if the

neoplasm be interfered with surgically, it should be widely removed. *Adenomata of the salivary glands, nævi, and lipomata* are all rare, especially the last named. Growths in this region may be removed either from the buccal aspect or often more conveniently, when large, by an incision placed within the arch of the lower jaw on the cutaneous surface between the jaw and hyoid bone.

Cystic tumours in the floor of the mouth (sublingual cysts) may be divided into the following:—(1) *Ranula*, (2) *dermoid cysts*, (3) other very rare cysts, such as *hydatid cyst*.

(1) *Ranula* (Fig. 739), by far the most important, is a bluish, semi-transparent, thin-walled, smooth ovoid or globular cystic swelling,

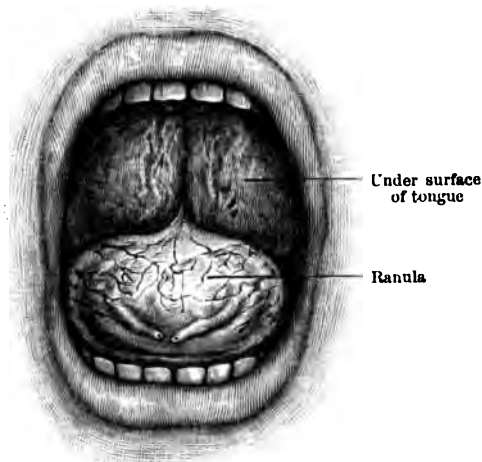


Fig. 739.—*Ranula*, showing the translucent Cystic Swelling. The ducts of Wharton are well seen. The tongue is lifted up so that its under surface alone is shown. (From a patient at Charing Cross Hospital.)

larger below than above, located in the floor of the mouth under the fore part of the tongue, usually unilateral, more rarely bilateral, and always containing a glairy mucoid fluid. The cyst may reach the size of a plover's egg. The pathology of this condition has long been very dubious. It is maintained that the swelling is due to dilatation of Wharton's duct. In certain cases this is unquestionably true; but frequently in a ranula Wharton's duct is patent, and a fine probe may be passed along it, making manifest the fact that the duct and the cyst do not communicate one with another. Others have held, apparently without evidence in support of their contention, that the sublingual gland and duct of Bartholin are sources of ranula. Possibly in certain cases ranula is due to distension of Fleischmann's bursa, a sac which lies between the mucous membrane and the genio-hyo-glossus—i.e. on each side of the frænum. The typical ranula is certainly, as first pointed out by von Recklinghausen, frequently a retention cyst of the mucus-secreting glands in

the floor of the mouth, particularly of the so-called Blandin-Nuhn gland, a mucous gland found on the under surface of the tongue near the middle line. In certain instances a ranula has developed after removal of the tongue for cancer. There is little doubt that in such cases the swelling is a retention cyst caused by injury to Wharton's duct. A ranula has also been known to develop as a result of injury to the duct caused by the slipping of the dental forceps during attempted extraction of a tooth. A ranula is painless, and after attaining a certain size (usually about that of a walnut), does not tend to increase. It interferes, however, with speech and swallowing by restricting the movements of the tongue, which organ it pushes upwards and backwards. The mucosa is quite non-adherent over the thin cyst wall, superficial to which numerous vessels may be seen to ramify.



Fig. 740.—Dermoid Cyst of Floor of Mouth (Lingual Dermoid). Swelling seen projecting between chin and hyoid bone. (From a patient at Charing Cross Hospital.)

Treatment. — Many methods have been employed with varying success. It may be briefly stated that simple incision is insufficient, and that complete excision is often scarcely possible, owing to the cyst being too thin. A seton is recommended by many surgeons, but is not reliable. It causes at times much inflammation, which may lead to abscess formation. A satisfactory result will be obtained by simply cutting into the swelling, avoiding Wharton's

ducts in making the incision, emptying the cyst of its glairy contents, painting the interior with some caustic (nitrate of silver, 40 grs. to 3j, or chloride of zinc, 40 grs. to 3j, or pure carbolic acid), and then stuffing the cavity with iodoform gauze, which is to be frequently changed. In this way obliteration of the cavity is obtained.

(2) *Dermoid cysts* (Figs. 740, 741) of the floor of the mouth, or Lingual Dermoids, are occasionally seen; most frequently they are met with in the median line between the genio-hyo-glossi and above the genio-hyoidei (Fig. 741). Much less frequently they are situated external to the genio-hyo-glossus. In all cases they lie above the mylo-hyoid. They are, of course, always congenital, but may not become manifest for many years, usually not before puberty or even later, when for some unexplained reason they may rapidly increase in size. They may be attached either to the hyoid bone behind or to the lower jaw in front. They owe their origin to the inclusion of a minute portion of epiblast or of hypoblast, but whether in connection with the formation of the stomodæum, the fusion of the two halves of the mandibular bar, the obliteration of the first

branchial cleft, or, as appears far more probable, with the thyro-glossal duct, is at present undetermined, though the strong balance of probability, amounting almost to a certainty, lies in favour of the commoner median cysts being due to non-obliteration of the thyro-glossal duct. These cysts (Fig. 741) have the structure of ordinary dermoids, their walls are lined by stratified epithelial layers, and their contents are chiefly sebaceous material, and frequently hairs and cholesterine. In other cases only a dark-coloured mucilaginous fluid is seen.

In appearance they present themselves as smooth, roundish, elastic fluctuating swellings, but the exact form cannot be determined in

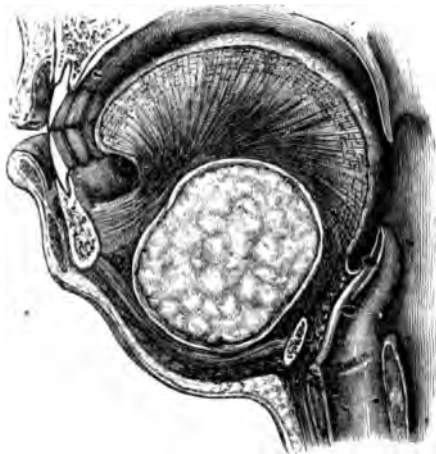


Fig. 741.—Representation of the Case shown in the previous figure. Dermoid Cyst (Lingual Dermoid) lying above genio-hyoid muscles, and extending upwards between and separating the genio-hyo-glossi. This cyst was not attached to the hyoid bone as is generally the case with similar tumours.

many cases, owing to the intervention of the muscles. They are non-transparent, and project much more towards the cutaneous surface than underneath the tongue. These points, with their median situation and slow growth, serve to differentiate them from ranula. The mucous membrane covering them is normal in appearance. When much enlarged, the cyst may pass upwards between and separating the genio-hyo-glossi, and reach to within one-third of an inch of the dorsum of the tongue. These cysts seldom cause trouble until they have attained a size considerably larger than that of a walnut, and even then the sole inconvenience caused by them is due to their bulk, which may hinder swallowing, speech, and, in extreme cases, respiration.

Treatment.—Extirpation of the cyst is radical, satisfactory, and usually easy. It is always to be recommended. The older treatment of incision with cauterisation of the interior of the cyst or drainage

of the cyst cavity, is tedious and uncertain. It is often recommended to remove the cyst through the mouth by incising the mucosa underneath the tongue, and thus avoiding an external scar. This method endangers Wharton's duct and other structures, and is liable to be followed by septic inflammation and suppuration, with their attendant dangers. It is, therefore, advisable to remove the cyst in every case by means of a median incision between the chin and hyoid bone. In this method the hæmorrhage is almost nil, provided the median line be adhered to. The wound can be kept aseptic, and the cicatrix is almost imperceptible, being hidden by the prominence of the chin.

(3) *Hydatid cyst* is very rarely seen in the floor of the mouth. Probably, as Langier suggests, when it occurs it is due to the embryo of the parasite directly penetrating the thin mucosa of this region, and developing *in situ*.

Affections of the submaxillary gland.—This gland is remarkably protected by the jaw and tongue from *injury*. It may, however, be damaged by the slipping of dental forceps or other instruments in operations upon the teeth of the lower jaw; more frequently, however, its duct (Wharton's) or the sublingual gland will be thus injured. Such an injury may lead to tearing of Wharton's duct, with subsequent cicatricial contraction; to inflammation, ending in suppuration of the gland; or to obliteration of one of the branches of the duct, with formation of a retention cyst.

An *acute inflammation* of the gland may occur, and frequently the submaxillary gland becomes involved with the parotid in mumps. Possibly in some cases of mumps the submaxillary glands are alone involved, the parotid escaping entirely.

The duct of Wharton, or one of its branches, may be blocked by the formation of a *salivary calculus*.

Acute ranula, as it is sometimes termed, is a peculiar condition, which is not duly appreciated. It is a sudden swelling of the submaxillary gland, which rapidly becomes tense, painful, and firm. Great pain is experienced at times, especially when food is taken. The gland may be felt distinctly enlarged by one forefinger in the mouth and the other below the jaw, and pressure much aggravates the pain. The cause is a sudden obstruction of the duct with accumulation of much saliva behind the obstruction. This obstruction is, according to my experience of four cases, usually due not to a distinct calculus, but to a firm plug of mucus not unlike wax in consistence, which may be partially extruded at the orifice of the duct, or may become firmly impacted at any part of its course. A similar condition does not occur in the parotid duct, owing doubtless to the fact that the parotid is a purely serous salivary gland, and mucus is absent from its secretion.

The *treatment* of this condition is to endeavour to press the obstructing mass along the duct, failing which, the part being painted with cocaine, a linear incision may be made with a sharp knife into the obstructed duct and the plug removed. The opening closes almost at once.

New growths may rarely be met with in the submaxillary gland, such as adenomata, chondromata, sarcomata, epitheliomata, and carcinomata. Tumours of mixed composition are less rare. More frequently the gland is secondarily involved in epitheliomatous growths of the tongue, jaw, and floor of the mouth. When thus affected the gland may be extirpated. An induration of the gland, the result of chronic inflammation, sometimes of syphilitic origin, must not be mistaken for a neoplasm.

The sublingual gland is very rarely the seat of any primary affection.

In this place it will be well to describe two morbid conditions of the salivary ducts, salivary calculus and salivary fistula.

Salivary calculus (Fig. 742, A).—A calculus may exist in connection with any of the salivary glands, most frequently the submaxillary glands. It is not common, but may give rise to much inconvenience. The *concretion* consists chiefly of phosphate and carbonate of calcium. It may remain embedded in the glandular substance, in which case it gives rise to no symptoms; it may block the main duct, or one of its chief branches, entirely, or may pass along the duct, and after causing much pain may be expelled. In size it may vary from a tiny, scarcely visible particle to a mass the size of a bean or more rarely a walnut. The concretion may form around a foreign body which has gained entrance into the gland. If situated in the duct it can almost always be felt from within the mouth, as a body as hard as a stone in the course of the tube.

Symptoms.—If it entirely obstructs the duct it will cause retention of the saliva, and this distending the gland will give rise to pain, swelling, and increased firmness to the touch, these symptoms being distinctly exaggerated on taking food. Swelling, pain, distension, and increased hardness of a single salivary gland should cause the surgeon carefully to examine for salivary calculus, which, if present, is usually to be felt by the finger in the mouth.

Treatment.—The clear indication is to remove the concretion at once; this may be effected in certain instances by pressing it onwards towards the orifice of the duct. Here, however, in most cases the calculus becomes impacted, owing to the fact that the orifice is the narrowest point of the duct. There is also danger of fracturing the calculus in the duct, and thus lacerating the wall of the tube. It is probably, therefore, always better to make a linear incision into the duct from the buccal aspect over the calculus through which the concretion may be readily expelled. This incision, which can be made under cocaine, heals quickly, as a rule; should it not do so, the saliva can be discharged into the mouth through the opening, without causing any inconvenience. Unless removed by timely operation, the calculus sets up inflammation, and often suppuration, which may end in the formation of fistulous openings. (See page 369.)

Salivary fistula (Fig. 742).—This term is applied to an abnormal opening, by means of which saliva finds an exit either into the cavity of the mouth, or externally on to the cutaneous surface. The former

class of fistula (opening into the mouth) has little importance, and rarely calls for treatment. Those fistulæ, however, which open externally usually demand surgical interference. The less frequent variety is that in which one or more lobules of the gland have been caused to communicate with the cutaneous surface, owing either

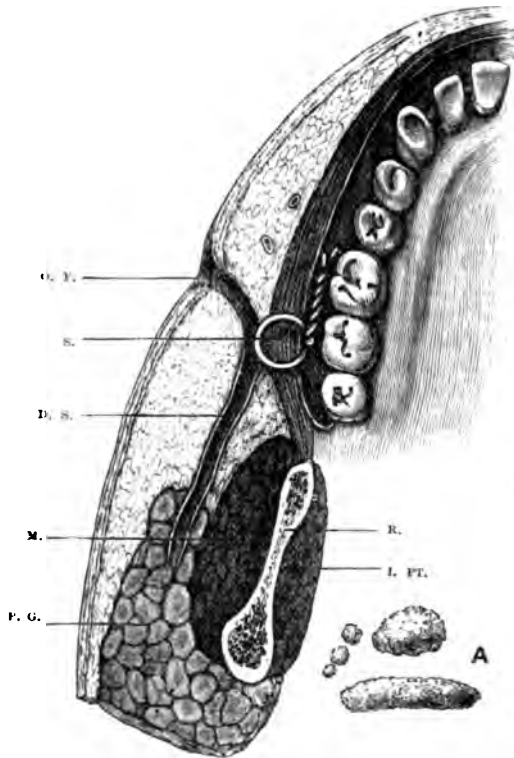


Fig. 742.—Salivary Fistula of Parotid Duct, showing method of operation recommended.
P. G., Parotid gland; M., masseter; I. PT., internal pterygoid; R., ramus of jaw; P. D., parotid duct (Steno's); S., loop of silver wire *in situ* strangulating tissue included in its grip; O. F., fistulous opening on cheek. A., shows salivary calculi. The long thin calculus came from the parotid duct, the others from the submaxillary gland.

to a cut penetrating the glandular substance, or to some destructive process opening into the same. In such a case saliva may trickle through the wound and thus cause the fistulous outlet to remain patent. It is usually found that only a small quantity of saliva escapes, as the duct being uninjured the greater part is carried by it into the cavity of the mouth. Should the fistula persist, it may generally be made to heal by one or two applications of the Paquelin or the electric cautery.

The more frequent and more troublesome form of fistula is one in

which the duct of the parotid (Steno's) has been wounded or has suffered partial loss of substance, owing to some ulcerative process extending to it, or to an abscess forming in connection usually with an impacted salivary calculus. The condition is readily recognised, as there is seen on the cheek a small fistulous opening, whence saliva oozes over the cheek instead of finding its normal exit into the cavity of the mouth. It is usually possible to pass a fine probe through the fistulous opening into the duct. (*See page 369.*)

Treatment.—No operative treatment should be adopted until it is clear that any ulcerative process is at an end and not liable to recur. The great indication is to re-establish a perfectly free opening of the duct into the mouth, in order to enable the saliva to find its way readily into this cavity. To effect this, a trochar may be used to penetrate the mucous surface of the cheek, from the bottom of the fistula once in a forward and again in a backward direction, so that an interval of $\frac{1}{4}$ -inch or thereabouts may intervene between the two orifices on the surface of the mucosa. Through each of these one end of a silver thread may be passed, so that a loop may present externally and the two free ends in the cavity of the mouth. These may now be tied tightly, and the wire left to ulcerate its way into the mouth. A passage will thus be obtained for the saliva into the mouth. The edges of the external fistulous opening may then be cauterised, when probably healing will occur. In some cases the edges may require paring and accurate suture.

AFFECTIONS OF THE TONGUE.

Development of the tongue.—This organ is formed of two rudiments, at first completely separated—an anterior median swelling, the tuberculum impar, from which the body and the tip of the tongue are developed, and a posterior V-shaped ridge, which gives origin to its root. The diverging arms of the V embrace the tuberculum impar and fuse with it. At the angle of the V is a diverticulum, whose mouth persists in the adult as the foramen cæcum. This diverticulum—the thyro-glossal duct—extends from the foramen cæcum to the front of the upper part of the trachea, and normally disappears entirely between its two ends, its lingual extremity giving rise to the foramen cæcum, whilst from its tracheal extremity, which bifurcates, the isthmus of the thyroid body takes origin. As development proceeds, the growth of the body of the hyoid bone separates the thyro-glossal duct into an upper portion, the lingual duct, and a lower segment, the thyroid duct. Occasionally one or other of these segments persists and gives rise to conditions, the origin of which has only within the last few years been clearly explained.

Two abnormal conditions of the lingual duct may here be mentioned:—

(1) Abnormal patency of the upper part or even the whole length of the lingual duct.—In such cases the surgeon can pass a fine

probe some lines down the lingual duct from the foramen cæcum ; and in rare cases even as far as the hyoid bone.

(2) Lingual dermoids.—These interesting and not really rare tumours owe their origin to some abnormal closure of the upper part of the lingual duct, occurring before the lower part has become obliterated. They are, in fact, in all probability, retention cysts of the lingual duct, and have been described under tumours of the floor of the mouth.

Absence of the tongue (aglossia) has been observed. It is infinitely rare. Only less uncommon is the condition in which the tuberculum impar and posterior ridge have failed to unite, and are represented as two small, but usually movable, nodules. Bifidity of the organ and extreme length without abnormal thickness are very rare. The large majority of defects of the organ are acquired, not congenital.

Tongue-tie.—Infants are very frequently brought to the surgeon by anxious mothers, who complain that the child is tongue-tied. It may safely be said that not once in fifty times is there sufficient tongue-tie to necessitate, or even to justify, operation. Some authorities have even doubted the real existence of the condition.

It certainly, however, is met with occasionally in a marked degree, though it is a rare deformity. The condition is due to the frænum linguæ being too short or too broad, and at the same time attached too far forwards to the under surface of the tip of the tongue. This, when marked, prevents sucking, and later, impairs speech. When the tongue can be protruded beyond the upper incisor teeth, there is no amount of tongue-tie present requiring operative interference. When this is impossible the latter will be indicated.

Treatment.—With a pair of scissors snip the edge of the tight frænum, and introducing the finger under the tip of the tongue, complete the necessary freeing of the organ by slight tearing. The cut should be made downwards towards the floor of the mouth, thus avoiding the ranine vessels on the under aspect of the tongue.

In rare instances the frænum linguæ is too long ; in such cases, and more frequently in those in which the frænum linguæ has been unnecessarily extensively divided, there is a risk of "tongue swallowing," a condition in which, owing to the laxity of the attachment of the organ, it can be drawn or can fall backwards over the upper orifice of the larynx, and may thus cause death from asphyxia.

Atrophy of the tongue.—This does not occur as a primary affection. It is, however, a frequent result of bulbar paralysis when, as is ordinarily the case, the nucleus of the hypoglossal nerve has become involved.

Hemiatrophy—i.e. atrophy of one lateral half of the tongue—is much less uncommon. It is seen most frequently as the result of interference with the hypoglossal nerve in its course from its

origin to its distribution by wounds, tumours, suppuration in the neck, caries of the occipital bone or atlas. It has also been noticed in syringomyelia, syphilis, general paralysis of the insane, and in locomotor ataxy, in which cases the condition owes its origin to a central cause. The atrophied part is shrunken and furrowed. The functions of the part are rarely appreciably affected by wasting of



Fig. 743.—Macroglossia. (Sutton, after Humphrey.)

one half of the organ. No treatment is of any avail in hemiatrophy of the tongue.

Hypertrophy of the tongue.—Macroglossia (*μακρός*, great; *γλῶσσα*, the tongue)—lymphangioma cavernosum or prolapsus linguae—is a rare form of enlargement of the tongue, which in extreme cases produces frightful deformity (Fig. 743).

Symptoms.—The condition is far most frequently met with as a congenital affection, though it may not be observed at birth, being, in fact, usually first noticed during the first or second year of life; it may, however, be acquired, but such cases are mostly those of enlargement due to chronic inflammation of the organ. The affection has been considered to be caused by abscess,

mercurial glossitis, or injury ; such conditions may cause the form of enlargement, the result of a chronic inflammatory process in the organ, but the true macroglossia is essentially a lymphangioma cavernosum, due to some interference to the return of lymph circulating in the organ, and is of congenital origin. It is noteworthy that enlargement of the organ affects chiefly, in most cases almost exclusively, the anterior two-thirds of the organ, that is, the part derived from the tuberculum impar. Possibly the lymphatic obstruction has its site in the boundary line separating the two segments of which the tongue is formed. Certain it is that lymphatic obstruction towards the base of the organ is the *fons et origo mali*, though the cause of the obstruction is obscure. In slight cases the tongue may still be retained within the mouth, when it tends to displace the teeth, and, by friction against them, becomes superficially excoriated ; in this stage the papillæ are seen to be hypertrophied. In more marked examples (prolapsus linguæ) the tongue cannot be retained in the buccal cavity, owing to its size. It therefore protrudes from the permanently open mouth, whence saliva runs continuously and copiously. The exposed surface of the tongue becomes dry and fissured, and even in spots ulcerated. The organ presents the appearance of a swollen purplish, or somewhat brownish shapeless mass. This prolapse naturally interferes considerably with speech and deglutition, though it is practically painless. The tongue is liable to attacks of inflammation, each succeeding one leaving the organ larger than before. The weight of the greatly enlarged organ displaces the teeth, and may even cause dislocation of the lower jaw. Macroglossia is generally symmetrical, both halves of the tongue being similarly affected, and may remain stationary for years. It never diminishes in size, however, its tendency being towards further overgrowth.

The *pathology* of this disease is closely allied to elephantiasis. There is great hyperplasia of the connective tissue of the tongue, and also increase in size of the blood-vessels, but the essential and certainly the primary condition is to be found in the state of the lymphatic system of the organ. Both macroglossia and macrocheilia have fundamentally the same pathology. They are examples of lymphangioma cavernosum, and consist of collections of dilated and varicose lymphatic vessels and cavernous lymphatic spaces, which during life are fully distended with lymph. These overgrown and dilated lymphatics displace the muscular fibres of the organ, and by their continuous pressure cause their atrophy. It will thus be seen that it is by no means a true hypertrophy of the tongue. Heredity apparently has no influence in the production of the condition.

Treatment.—So long as there is no prolapsus linguæ the tongue must be retained in the mouth, which is kept closed by a bandage, and only opened to allow food to be taken. When the condition has reached the stage of prolapse, operative interference is called for. (Pressure, often suggested, is of little avail, very irksome to the patient, and difficult of application.) A V-shaped portion of the

organ should be removed with its apex directed backwards, and the edges of the incision brought together so as to fashion a new tip, or in extreme cases the part projecting beyond the teeth may be simply amputated. The galvano-caustic wire or *ecraseur* sometimes recommended may be used, but there is no need for their employment, as the bleeding is not serious.

The results of amputation of the prolapsed portion are surprisingly good, both as regards the small mortality and the improved functional state of the organ.

Hypertrophy of the tongue is very rarely *the result of an acute glossitis* or of oft-repeated chronic superficial inflammatory attacks. When the condition is thus caused there is no lymphatic dilatation as in *macroglossia*, from which it is thus to be differentiated. Little or nothing can be done to relieve such an enlargement. Fortunately, there is little tendency to continuous increase in size.

The term *syphilitic hypertrophy* is given to a condition in which either numerous small *gummata* exist in the organ, causing its enlargement, or deep fissures on the dorsum lead to increase in the size of the ridges lying between them. In the former case *antisiphilitic* treatment will rapidly, in the latter case it may slowly, reduce the enlargement.

Strictly speaking, none of these conditions—*macroglossia*, enlargement due to inflammation, or *syphilitic* enlargement—are instances of hypertrophy in the strict pathological sense of the word.

Acute parenchymatous glossitis.—This is a rare affection, less rare in adults than in children. It may be limited to one lateral half of the tongue (*hemiglossitis*), or may involve the whole organ. It is found as the result of stings of bees, wasps, or other insects, of injuries such as bites, cuts, etc., or of burns. It occurs in the course of specific fevers, usually then following upon the development of *stomatitis*. It may proceed from any ulceration of the tongue, especially from the little ulcers seen in *mercurial stomatitis*, or it may be caused by the spread of inflammation from neighbouring parts, *e.g.* the tonsils or the sublingual region. Occasionally no distinct cause can be assigned.

Symptoms.—Swelling is a marked symptom; the tongue may increase to thrice its normal bulk in the course of some hours. It protrudes from the mouth, and is painful, rigid, scarlet, engorged, coated with a puriform mucus, and frequently presents on its surface numerous small excoriations. Speech and the taking of food are rendered difficult or impossible, and the attempt causes great pain. In severe cases the swelling may be so extreme as to threaten *asphyxia*, and demand the performance of *tracheotomy*. The constitutional symptoms are always marked; there is severe suffering, elevation of temperature, profuse salivation, enlargement of the submaxillary and cervical glands, and the patient feels extremely ill. Often there is marked *asthenia*.

The *prognosis*, in spite of the formidable appearance of the condition, is decidedly favourable. The tendency is towards complete

recovery by resolution, the tongue resuming its normal size within a week of the commencement of the inflammation. Not uncommonly, however, some enlargement and induration may persist for a time, or even permanently. Less frequently a circumscribed abscess results; very rarely purulent infiltration of the whole organ is observed, this latter being a most serious affection, and one liable to result fatally from septicæmia or septic pneumonia.

Treatment.—Slight cases require only ice to suck continuously, a smart purge and an antiseptic mouth-wash. Severe types of the disease demand in addition to the above simple treatment, multiple scarification of the dorsum linguæ, or better a longitudinal incision made on each side of the median line midway between it and the margin of the tongue. This incision should cut into the muscular substance of the tongue, and may be unhesitatingly adopted, as the relief given is always marked and sometimes surprisingly rapid. These incisions, no doubt, diminish the risk of suppuration. Should an abscess have formed, however, vent should be given at once to the pus.

Hemiglossitis is a very rare affection, in which one half of the tongue only is affected. Curiously, this is almost invariably the left half of the organ. The condition is milder in degree than the ordinary form of acute parenchymatous glossitis, and subsides under simple treatment, incision being almost never required.

Abscess of the tongue.—Abscess may be the result of an acute glossitis. In certain cases there is seen a peculiar form of chronic abscess of the tongue, situated almost invariably just underneath the mucous membrane of the dorsum of the tongue. The abscess presents itself as a painless, firm, circumscribed, tense swelling, in which fluctuation may be felt. It is often diagnosed as a cyst. Frequently it is stated that such a swelling may be mistaken for carcinoma or gumma. In case of doubt, a puncture will decide the question at once. The abscess should be laid freely open, when rapid healing will generally result from the evacuation of the pus.

Superficial inflammations of the tongue.—Superficial acute glossitis is usually only a part of a general (*e.g.* mercurial) stomatitis, and demands no separate description.

Chronic superficial glossitis, otherwise called tylosis, psoriasis, leucoma, leucoplakia, or in more aggravated cases ichthyosis linguæ, is one of the most frequent and most important affections of the tongue. Its aetiology is, in spite of careful study on the part of numerous observers, still wrapt in much obscurity. It is a chronic inflammation of the mucous membrane of the tongue. The same condition to a less degree may also involve the mucous membrane of the cheeks and lips, which may present the localised thickening of the epithelium that characterises the disease. Several factors may contribute to the development of this condition; three, however, stand out prominent—syphilis, excessive smoking, and spirit-drinking; often these act in conjunction. Less important factors are hot condiments and spices, gout, many types of

dyspepsia, and irritation of the tongue from rough edges of teeth. The disease is much more common in men than in women, and is very seldom seen in childhood or in youth.

Three types of chronic superficial glossitis are to be recognised: (1) the red glazed tongue; (2) leucoma or leucoplakia; and (3) psoriasis and ichthyosis linguae.

(1) *The red glazed tongue.*—In this form there is seen a remarkable smoothness and redness of the tongue, which has the appearance of having been varnished after having been deprived of its epithelial covering. The smoothness is due to disappearance of the papillae of the tongue. In this condition there is combined an inflammation of the submucosa with the chronic inflammatory condition of the mucosa. The organ is usually somewhat enlarged, and the mucous covering is therefore stretched and thinned over it, hence the disappearance of the papillae.

The affection lasts for years unaltered, except that from time to time slight excoriations may form on its surface. There is usually a feeling of heat and smarting perceived, especially when any but the most bland forms of nutriment are taken. The condition is utterly intractable, and all that the surgeon can effect is to prevent the aggravation of the morbid process. Cure must not be expected.

In many cases this red glazed tongue is the precursor of leucoplakia; although this is denied by high authority, there can be no reasonable doubt of the correctness of the statement. Almost every surgeon has observed numerous cases in which leucomatous patches have developed upon red glazed areas on the dorsum of the tongue. Probably this occurs only in a certain proportion of cases, for there is little doubt that the red glazed condition may exist for many years without undergoing leucomatous change, and also that leucoma frequently develops without being preceded by the formation of red glazed patches. Rarely, a condition precisely analogous to that under discussion may be seen on the glans penis. I have seen an epithelioma develop upon the site of such a patch after it had existed for fifteen years.

(2) *Leucoplakia* or *leucoma* (Figs. 744, 745) is the most common manifestation of chronic superficial glossitis. It presents asymmetrical white patches of greatly thickened epithelium, which are raised above



Fig. 744.—Leucoplakia of Tongue, with red glazed patches on each side of the dense white epithelial thickening. (From a patient at Charing Cross Hospital.)

the level of the normal mucosa. These patches may be small in area, and few in number, or the tongue may be completely covered by this leucomatous epithelial thickening. These patches cannot be detached from the subjacent tissues without tearing and the production of hæmorrhage. The surface of the patch is firm, rough, dry, and horny. The degree of the whitish opacity depends upon the thickness of the epithelium. Cracks and fissures are commonly encountered in connection with this condition. There is chronic inflammation of the mucosa, with round-celled infiltration, and a great overgrowth of epithelium, the upper strata of which, undergoing horny degeneration, change colour, and may be cast off. This morbid overgrowth of epithelium may undergo still further development, and give rise to the formation of an epithelioma.

Commonly, the subjective symptoms of leucoplakia are very trivial.

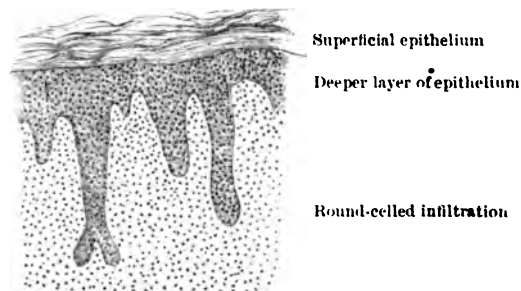


Fig. 745.—Microscopical Section (low power) of Leucoplakia, showing thickened epithelium. (From a preparation by Dr. C. J. Arkle.)

There may be a certain amount of pain, especially when irritating substances are taken into the mouth; but frequently the patient is unaware of the existence of the condition until it is pointed out to him by the surgeon.

Leucoplakia is a very intractable condition, as, indeed, are all varieties of chronic superficial glossitis. Patches may appear to be less distinctly marked under treatment, or they may almost disappear, only, however, to reappear in the course of a few weeks or months.

(3) *Psoriasis linguæ* is a term frequently employed to designate advanced cases of leucoplakia, in which the patches attain a considerable thickness. A rare form is that which has been by Hulke described as *ichthyosis linguæ*, in which the papillæ are much hypertrophied and covered by a horny overgrowth of epithelium. This condition may have a very warty appearance, and the surface of the tongue will be firm, hard, stiff, and cracked. Should the conical (or filiform) papillæ be chiefly thus affected, the surface of the organ is covered by stiff hair-like processes, much like the tongue of the *carnivora*. This rare condition is known as *hairy tongue*.

Prognosis.—Cure of chronic superficial glossitis cannot be expected. The surgeon's endeavour must be to prevent the condition from becoming worse. He must ever have in mind the possibility, and in aggravated cases the probability, of epithelioma developing. Should any leucomatous patch manifest signs of persistent ulceration or induration, it will be wise at once freely to excise it.

Treatment.—Avoidance of every possible source of irritation, especially smoking and spirit drinking. Iodide of potassium and mercury should always be tried in cases due to syphilis, for though their effect is not marked in certain cases, they in general seem to give distinct (even though only temporary) relief. Glycerine and borax may be given as a local application, and a solution of chlorate of potash, 3j to ʒvj, as a mouth wash. Salicylic acid or chromic acid (1 per cent. solution) are often recommended to be applied with a brush to the patches and cracks. I have, however, seldom seen good result from these applications, and consider that active local treatment is in general inadvisable.

Certain rare affections of the tongue.—Several very rare affections of the tongue may here be briefly alluded to.

Urticaria may affect the tongue. It occasions marked temporary swelling of the organ and a varying amount of pain. Its first onset may give rise to mistaken diagnosis. The tendency to recurrence, however, will enable certainly on its second appearance the surgeon correctly to diagnose the condition. When marked it is sufficiently alarming, but disappears in a short space of time.

Geographical tongue, annulus migrans, or eczema of the tongue is a remarkable condition, which is chiefly met with in weakly, ill-nourished children, though it is not very rare in adults. There are formed small red patches the size of a pea, which are, to begin with, flush with the general surface of the dorsum of the tongue. There is marked desquamation of the epithelium and the papillæ disappear over the surface of the patch, which, increasing in size, becomes annular, the process subsiding in the centre and spreading at the periphery. From the coalescence of several such rings an irregular, well-outlined figure is produced, to which the term geographical tongue has been applied. The condition is not very painful, though there is a sensation of heat and itching and an increased flow of saliva. It is, however, of a very chronic nature. Its ætiology is quite obscure. Though often called *tinea tonsurans*, it has no connection with the *trichophyton tonsurans*, and probably is not of parasitic origin. The part may be painted with a solution 10 grains to the ounce of nitrate of silver. This relieves the smarting. The condition is very apt to recur, and may last for months. Local treatment is, as a rule, ineffective.

Herpes of the tongue affects chiefly the tip and sides of the organ, where the vesicles, soon becoming pustules, may be in rare cases observed, especially in alcoholic dyspeptics. A mild astringent or antiseptic mouth wash, with internal administration of rhubarb and magnesia, is the only treatment required.

Pemphigus.—In this rare condition we see very much larger vesicles involving the tongue and mucosa of the cheek.

Lichen of the tongue may occur in the form of whitish spots, which may become confluent. According to Butlin, lichen of the skin is always present.

Nigrities linguae, or black tongue, is a rare condition, in which black spots are seen on the dorsum of the tongue. Their ætiology is at present obscure.

Ulcerations of the tongue.—These may be classified as simple, aphthous, mercurial, tuberculous (including lupoid), syphilitic, and malignant.

The aphthous and mercurial ulcers have been described under stomatitis. Tuberculous, syphilitic, and malignant will be dealt with under their appropriate headings. Here the varieties of simple ulcers may be described.

Simple ulcers.—Simple ulcers are divided into the dyspeptic and the traumatic (including the dental) ulcers.

The *dyspeptic ulcer* occurs most frequently in ill-nourished children and overfed adults. It may be seen in connection with any disorder of digestion.

These ulcers are situated chiefly on the dorsum and sides of the tongue near the tip, less frequently on the under aspect of the tongue and on the borders of the organ near to the molar teeth. The ulceration is often multiple, and covers a somewhat large area of the tongue. Each ulcer is superficial, more or less circular, often covered by greyish-yellow slough, and the margins are much inflamed. There is no induration, but the sore is very painful. The mouth is foul, and there is disinclination to take food. The lymphatic glands may be inflamed.

As to treatment, the chief indication is to correct errors in diet, to treat the dyspepsia, and to employ a mild antiseptic mouth wash.

The *traumatic ulcer* (including the dental ulcer).—This ulcer may be caused by many different varieties of injury, but most frequently it is due to rough carious teeth, against which the tongue rubs (*dental ulcer*). The ulcer is usually situated on the margin or tip of the tongue, and in relation to a sharp edge or carious surface of a tooth. It starts as a slight abrasion, which, should the cause of the irritation be removed, will heal readily. If the irritation persists, the abrasion extends into a definite ulcer, which is irregular in outline, with distinct edges, a red inflamed areola, and often a sloughy base. It is now painful, but without induration. After the ulcer has been in existence for some weeks, or even months, it gradually assumes a callous appearance, the redness disappears, the edges increase in depth and firmness, and induration begins to be manifest. These ulcers have to be distinguished from those due to syphilis and tubercle. Often when they have been in existence for some months, and induration has become a marked symptom, the differential diagnosis from epithelioma may be a matter of the greatest difficulty.

It is obvious that the essential method of treatment is to insist upon the removal of the source of irritation. The tooth must be smoothened or removed, and the mouth kept clean. The ulcer, if in the early stage, will then readily heal. Should it refuse to do so, and tend to spread whilst it feels distinctly indurated, the surgeon will do wisely to consider the appearance indicative of epitheliomatous infiltration, and will freely remove the ulcer whilst the condition is still localised.

In whooping cough a peculiar ulcer is often seen under the tongue near the frænum. It probably is a traumatic ulcer due to the rubbing against the teeth in the protrusion of the tongue, so characteristic of severe coughing in children.

Tuberculous disease of the tongue. — *Lupus* very rarely, if ever, attacks the tongue exclusively. When present on the tongue it is almost always found in conjunction with lupus of the cheeks, lips, nose, or palate. There can, therefore, scarcely be any doubt whatsoever as to the diagnosis of the condition. Regarding the treatment of lupoid ulceration of the tongue, probably the best results will be obtained by freely scraping the ulcers with Volckman's spoon, and then applying the Paquelin cautery to the raw surface, which should be dusted with iodoform. The administration of cod-liver oil, iron, and strychnine will be a useful adjunct to local treatment.

Tuberculous ulceration of the tongue (Figs. 746 and 747) is a somewhat rare though important disease. It is a curious fact that the striking symptoms of this affection escaped the notice of surgeons up to within a comparatively recent time, it being now some thirty years since the condition was first described. Very rarely indeed is the lingual ulceration the primary manifestation of the disease. In a very large majority of cases it is secondary to tuberculosis of the lungs or larynx, or is part of a general tuberculous infection.

Symptoms.—It is most frequently seen in people between the ages of fifteen and thirty-five; rarely does it occur at an earlier period of life, though it may be found at a later age. The disease commences on the dorsum of the tongue near the tip, or more frequently involves the tip itself. It usually begins as a small nodule, which slowly gives place to an ulcerated surface; in certain cases, however,



Fig. 746.—Tuberculous Ulcer of the Tongue.

the ulcer seems to be the starting-point, there being no preceding nodular formation. The ulcer has an irregular outline, the base is uneven, nodular, sloughy, or caseous; the edges are sharply defined, rarely undermined, everted, or thickened; there is very little induration, more often none at all; the inflammatory areola is little

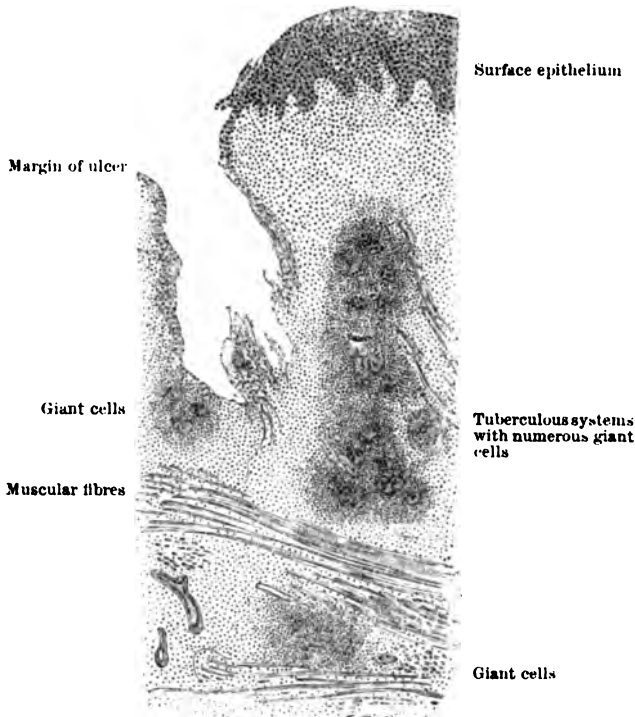


Fig. 747.—Section (low power) from the Margin of a Tuberculous Ulcer of the Tongue, showing numerous giant cells and tuberculous systems. (From a preparation by Dr. C. J. Arkle.)

marked, the ulcer being pale with flabby granulations, and the discharge is thin and serous. On close examination a number of miliary tuberculous nodules are usually to be seen situated around the periphery of the ulcer. The sore is extremely painful, especially in the later stages, when, in order to relieve continual suffering, it is often advisable to divide the lingual nerve, or, preferable, to excise a portion of it.

The tuberculous ulcer may be difficult to diagnose from tertiary syphilitic and cancerous ulceration. It is sometimes recommended to remove a small fragment, in order to submit it to microscopic examination for the tubercle bacillus. The finding of this organism at once settles the diagnosis, but it must be freely admitted that it may

not be found in cases which are undoubtedly tuberculous. Should tuberculous disease of lungs or larynx be present, along with ulceration of the tongue, the strong probability is that the latter is of the same nature as the former. The lymphatic glands are not affected, except perhaps sometimes in the very latest stages of the disease.

Prognosis in all cases is distinctly bad, scarcely less unfavourable than that of malignant ulceration. Healing does, however, sometimes, but very rarely, take place. Frequently the ulcer remains for weeks or months almost stationary, at other times it may advance rapidly, and spread deeply into the substance of the tongue. In the very rare cases of primary tuberculosis of the tongue the prognosis is obviously more favourable. In the more frequently observed cases, in which the tuberculous ulceration is secondary to tuberculosis elsewhere (especially in lungs and larynx), the outlook is far more gloomy. When the ulcer makes its first appearance in advanced phthisis it rapidly hastens the fatal termination by reason of the interference with nutrition, which is caused by the pain on taking food, and its appearance is, therefore, a most ominous symptom. In the great majority of cases the development of a distinct tuberculous ulcer of the tongue means death to the patient within two years, frequently in a far shorter time.

Treatment.—For some time tuberculous ulceration of the tongue was considered by surgeons a disease unsuitable for operative treatment. It must be confessed that radical treatment even nowadays rarely achieves much success. In cases, however, where the ulcer is very painful, and no advanced tuberculous process exists elsewhere, it is advisable either to excise or freely to scrape the ulcer with a Volckman's spoon, and then cauterise the raw surface. In cases which are clearly inoperable, finely-powdered iodoform or boric acid, to which a small quantity of morphine (2 per cent.) is added, may be dusted on, or the ulcer may be painted with a 2 per cent. solution of cocaine. Food as little irritating and as nutritious as possible must be administered, and an antiseptic mouth wash (1 per cent. carbolic acid) or chlorate of potash (3j to ʒvj) should be made use of after each meal. Cod-liver oil and tonics will also be given. If the pain should be very severe, as a palliative measure division, or better, excision of a piece of the lingual nerve, as mentioned above, may be resorted to, with at least marked temporary relief.

Syphilitic affections of the tongue.—These affections are by far the commonest diseases of this organ with which the surgeon has to deal. Such conditions may be classified as primary, secondary, and tertiary syphilitic affections. The first is decidedly rare; the two latter are exceedingly common.

Primary syphilis of the tongue is seen in the form of indurated chancre. This condition is less frequently observed on the tongue than on the lip, but in contra-distinction to chancre of the lip it occurs more frequently in men than in women. The chancre is usually single. It commonly commences as a small pimple,

which breaks down by ulceration, and soon becomes indurated. Enlargement of the nearest lymphatic glands occurs here, as in primary chancres elsewhere, as an early symptom and materially aids the diagnosis. The sore heals readily under the influence of mercury; phagedæna has been known to occur, but is decidedly unusual. The only point of difficulty is the diagnosis, as in these cases it may be difficult to extract from the patient an avowal of exposure to infection. The appearance of secondary symptoms in a few weeks will certainly settle the question.

Secondary syphilis of the tongue manifests itself in two chief forms—(1) as mucous plaques; (2) as superficial ulcers. *Mucous plaques* or tubercles may occur during any period of the secondary stage of the disease; they are formed by thickening of the epithelium overlying inflamed and swollen papillæ. They have a greyish white appearance, are slightly elevated, and the epithelial coating is readily detachable from the reddened subjacent surface. They generally are found accompanying other similar patches on the lips, cheek, palate, or tonsil. They are observed alike in hereditary and in acquired syphilis, and are far more common in men than in women. The tendency to their development existing in secondary syphilis, their situation is determined by local irritation; thus we meet them chiefly on the tip, margins, and dorsum of the tongue, rarely on the under surface of the organ. They are usually only slightly painful, and are more frequent and more severe in patients with unclean mouths and in smokers.

Superficial ulceration of the tongue is frequently found in secondary syphilis. The ulcers are located especially on the margins and tip of the organ, and are usually found along with similar sores upon the mucosa of the lips, cheeks, palate, tonsils, or at the angles of the mouth. They are but slightly inflamed, have abrupt sharp-cut edges, are mostly round, with greyish floor, are multiple, and painful. They may extend superficially or deeply; frequently, when severe, they give rise to fissures and cracks, which in healing leave depressed linear cicatrices.

Treatment of secondary syphilis of the tongue.—The internal administration of mercury and the due cleansing of the buccal cavity are the two essentials of treatment. The latter indication is best met by the oft-repeated employment of a mouth wash of corrosive sublimate (1 to 2,000) or by painting the ulcer or mucous plaques with a solution of 1 to 200 of the same. The prognosis is good, treatment being most efficacious.

Tertiary syphilis of the tongue produces two varieties of lesions. In both we have, as a first stage, small-celled infiltration. This, here as elsewhere, may either be general and become organised into fibrous tissue, from which result the so-called scleroses of the tongue; or it may be localised in one or more spots, and give rise to a gumma, from the breaking down of which the typical gummatous or tertiary syphilitic ulcer results. In the same tongue sclerosis and gumma formation may co-exist; more often, however,

we find either process separately. These affections are rarely seen before the fifth year after infection; they may make their first appearance as late as twenty years or more after the development of the chancre. They, in common with all tertiary affections, are commonly found in cases in which antisyphilitic treatment has either not been properly and fully carried out, or has been altogether omitted.

Tertiary syphilitic sclerosis of the tongue (Figs. 748, 749) is well divided by Fournier into two varieties—superficial and deep. Superficial syphilitic sclerosis is an infiltration terminating in an induration of the deeper layer of the mucosa of the tongue. This leads to the development of smooth, stiff, parchment-like patches, which appear as if varnished, and from which the papillæ have disappeared. These patches may be confluent. They appear chiefly in the anterior part of the dorsum of the tongue and cause scarcely any appreciable pain.

Soon the surface becomes more or less deeply fissured, and these fissures are callous and extremely difficult to heal. The tongue is increased in size, as shown by the indentations of the teeth, and the ridges between the fissures become hypertrophied. The condition is a chronic inflammation of the mucous membrane of the tongue with destruction of the papillæ. A cure is impossible, because, though the process may be arrested by treatment, a cicatricial condition remains behind, and the fissured ridged tongue is liable at all times under slight provocation to inflame, and thus keep up and continue the morbid process.

In deep syphilitic sclerosis of the tongue the sclerosis is, as Fournier says, dermo-parenchymatous, there is infiltration of the whole organ, which in its earliest stage is hypertrophied and bears the impress of the teeth. Soon there results a stage in which the infiltration organises into septa of fibroid connective tissue. These septa traversing the entire substance of the tongue, and dividing it into pseudo-lobules, soon shrink and render the organ uneven, furrowed and nodular. With this deep sclerosing glossitis there is usually conjoined superficial sclerosing glossitis, which gives to the organ the appearance characteristic of the latter condition, and enables the surgeon to feel the superficial as well as the deep induration present in the organ. The scarred, disfigured tongue is covered by mucous membrane, in part normal in appearance, in part darkly congested and swollen, here red and smooth, there opaque

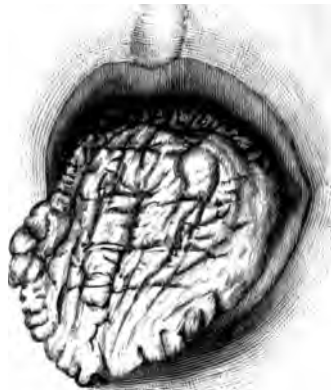


Fig. 748.—Tertiary Syphilitic Sclerosis of the Tongue. The organ is fissured and stiff, and its margins are serrated. (From a patient at Charing Cross Hospital.)

white, or bluish-white from heaping up of thickened epithelium. The furrows may deepen into raw fissures, and the nodular masses of tissue bounded by them may become ulcerated, in consequence of their undergoing gummatous degeneration or as the result of local irritation.

In the advanced stage the tongue feels much harder than normal,



Fig. 749.—Tertiary Syphilitic deep Sclerosis of the Tongue. The organ is enlarged, firm, and divided by septa into cuboidal pseudo-lobules. (From a patient at Charing Cross Hospital.)

and is divided up by furrows into pseudo-lobules (Fig. 749); the mucous membrane of the dorsum of the tongue is also firm and unyielding. All the above-described morbid conditions are chiefly seen on the dorsal aspect of the tongue.

(2) *Gummata of the tongue* have rarely been observed as a result of hereditary syphilis; almost always they are due to the acquired form of the disease. They may be multiple or single, more frequently the latter, and may vary in size between that of a hemp seed and that of a walnut.

A gumma is composed of a localised small-celled infiltration, which has, except in rare instances, no tendency to organise into fibrous tissue, as in the

sclerosing types of tertiary lingual syphilis; but on the contrary either undergoes absorption or more frequently degenerates, and breaking down gives rise to an ulcer—the so-called tertiary syphilitic or gummatous ulcer.

Lingual gummata are divided into superficial and deep; the former commence as localised infiltrations, either in the submucous stratum or in the deeper layers of the mucosa itself; they rarely attain any considerable size, are frequently multiple, and may be felt as nodular indurations.

The deep gumma lies in the muscular substance of the tongue. It is usually solitary, but not infrequently two, three, or more may co-exist. It causes no pain, and owing to this fact may not be noticed for some little time by the patient. It is palpable to the surgeon as a hard, firm, roundish swelling, which (unless absorbed) increases in size, undergoes softening, and ultimately involving the mucosa, which in the early stages is normal in appearance and freely movable over the swelling, opens on the surface of the tongue, and becomes transformed into an ulcerating cavity with irregular, soft, undermined margins, and containing an adherent slough resembling in appearance wet wash leather.

A deep gumma is most frequently situated near the middle line and under the mucosa of the dorsum linguae. After a gummatous ulcer has persisted for some weeks (usually without treatment) there may develop a certain amount of induration (Fig. 750), thus simulating epithelioma. Under treatment a gumma even of large size may be entirely absorbed without leaving any mark of its presence. More frequently it opens on the surface of the tongue and leaves a depressed linear or star-shaped cicatrix.

The diagnosis is not difficult when the gumma has been observed from the time of its formation to that of its breaking down into an ulcer. Before breaking down it might be mistaken for any deep-seated tumour of the tongue or for chronic abscess; after the gumma has given place to the ulcer this might be confounded with tuberculous disease, primary chancre, or more importantly with epithelioma.

It may be mentioned that the gummatous ulcer has little or no tendency to increase in size, that it is, unless irritated, at the worst only slightly painful, and that the lymphatic glands are, as a rule, not involved. In cases of difficult diagnosis reliance must be placed on the history, on any co-existing morbid conditions, and on the presence of scars and other traces of former manifestations of the disease. Microscopical examinations of scrapings from the ulcer, or better of a small excised fragment, will frequently throw much light on a diagnosis previously obscure.

The prognosis of tertiary syphilitic affections of the tongue is good regarded from the point of view of life. They are practically never fatal except in the cases in which gummatous ulceration, having persisted for some months, gives place to epitheliomatous infiltration. Gummata usually respond readily to antisyphilitic treatment, often with surprising rapidity. The sclerosing forms

of glossitis (both superficial and deep) are very resistant to treatment; usually little can be done for their relief.

Treatment of tertiary lingual syphilis.—Iodide of potassium is here our sheet anchor, and rarely fails to yield beneficial results in cases of gummata. It is frequently necessary to administer ample doses (gr. xx to xxx) thrice daily. Often it will be useful to give at the same



Fig. 750.—Gummatous Ulcer of the Tongue, which had been in existence for weeks, and the margins of which were somewhat indurated. Healing rapidly took place under the administration of iodide of potassium. (From a private patient.)

time mercury internally. In the later stages of sclerosing glossitis where we have to deal with deformities due to cicatricial contraction of fibroid tissue, a cure is impossible; no medication can restore the tongue to its normal state. Here we must be content with giving iodide of potassium from time to time, especially during inflammatory exacerbations and whilst the fissures are raw. These last may be painted with nitrate of silver (gr. xv to ʒj) or with a 2 per cent. solution of chromic acid. With this exception it is well to avoid any application of an irritating nature, and to confine the local treatment to washing out the mouth with a solution of chlorate of potassium, and to painting the tongue night and morning with glycerine of borax.

Actinomycosis of the tongue.—This affection, almost unknown in England, is not so infrequently met with on the Continent. Out of twenty-one cases of actinomycosis in Albert's clinique, from 1882 to 1888, in four instances the tongue was affected (Tillmanns). The tongue may, of course, be involved, together with other parts in actinomycosis, or it alone may suffer in consequence of direct infection conveying the fungus from a prick with a straw, or husk of wheat, or oats, etc.

The diagnosis is made by microscopic examination. (See p. 314, Vol. I.)

Treatment.—Removal as complete as possible of the focus of infection, either by excision or very free scraping, followed by cauterisation with the thermo-cautery.

Innocent tumours of the tongue.—Tumours of the tongue are divided into innocent and malignant. Innocent tumours occur less frequently than do malignant new growths. Many varieties of benign tumours affect the tongue. Every one is, however, somewhat rare, many are extremely rare.

Nævus is probably the most frequent of the innocent tumours of the tongue. Three varieties of nævus are usually described—capillary, venous, and arterial. It must be borne in mind, however, that most frequently two of these elements are combined. Thus an arterial nævus consists partly of capillaries; and the same is true of venous angiomas. Angiomas are, perhaps, best divided into simple angiomas, which consist of dilated and newly-formed vessels; and cavernous angiomas, which are built up of distinct cavities lined by endothelium, and containing blood. (See p. 580, Vol. I.)

The common veno-capillary nævus is bluish; the much rarer arterio-capillary is bright red in colour. Nævi of the tongue very rarely exceed an inch in diameter. They are usually congenital, and may disappear spontaneously. They are generally situated either just under the mucous membrane of the dorsum of the tongue or deep in the substance of the organ. In this latter situation they are almost always cavernous. Nævi may be single or multiple. In many cases the nævus can be emptied by pressure; in other cases this cannot be done, the growth then feeling cystic. The swelling is painless, and, when small, causes very little inconvenience. When

large, it is troublesome only by reason of its size. Over the sub-mucous nævi the mucosa is thinned, and contains numerous small varicose vessels, which aid materially in the diagnosis.

Angeiomata may spontaneously disappear, they may remain for years unaltered, they may rapidly enlarge, or may undergo degeneration, often of a papillomatous nature.

Treatment of nævi.—The galvano-cautery should be employed for almost all cases. If used at a dull cherry-red heat there will be absolutely no hæmorrhage, as at this temperature the cautery is a powerful hæmostatic. If used too hot, there may be much bleeding. The heated platinum blade must be inserted into the nævus, and moved freely about until the whole interior of the nævus is destroyed. Little reaction follows this treatment. Often a single application suffices to effect a cure; three or four applications should destroy the largest nævus. I have never seen a nævus of the tongue which could not be treated by this simple, safe, and effective method. Ligature and excision are often recommended, but are decidedly inferior to the cautery.

Lymphangeiomata of the tongue also not infrequently occur. Like the blood angeiomata, we may divide them into simple and cavernous lymphangeiomata. The latter are described under macroglossia (page 495), which is essentially a lymphangeioma cavernosum linguae. Simple lymphangeioma closely resembles a veno-capillary nævus in structure, differing from it only in containing lymph in place of blood. Sometimes little papillary projections containing dilated lymphatics are seen on the dorsum of the tongue. The condition frequently presents itself in the form of small vesicles on the dorsum of the tongue. It requires treatment similar to that of nævus.

Papillomata of the tongue are met with on the dorsum and margins. They consist of an overgrowth of the epithelium and of the connective tissue basis of the papillæ. They may occur at any age, and may even be congenital. They are usually pedunculated and non-indurated, this last point distinguishing them from carcinoma, into which, however, they may degenerate after becoming ulcerated from persistent irritation, especially in elderly people. Papillomata may also arise from degeneration of simple angeiomata, or more frequently of simple lymphangeiomata.

The best treatment is cutting them off with scissors or knife under cocaine. Should the hæmorrhage be severe, it can be stopped by the application of the galvano-cautery at a dull red heat.

Lipomata occur rarely on the tongue. The growth of a lingual fatty tumour is very slow. The swelling may distinctly give the feeling of fluctuation, and be mistaken for cyst or abscess. If causing inconvenience by its size, it can readily be enucleated by a linear incision made over it, as it is always encapsulated.

Fibromata not quite so rarely as lipomata occur on the tongue. They are usually very soft, and may be multiple. Not infrequently they present themselves as soft polypoidal growths on the dorsum.

When polypoidal, they must be cut off; when more deeply seated, enucleated. When the mucous membrane covering a fibroma is inflamed and ulcerated the condition may be with difficulty distinguishable from carcinoma.

Chondromata, osteomata, myxomata, and keloid growths have been described, but are too rarely encountered to merit description here.

Adenomata or glandular tumours of the tongue are exceedingly rare. They may be polypoidal or situated in the substance of the organ. They are either acinous or tubular in structure, and have been described as taking origin in the Blaudin-Nuhn glands under the tip of the tongue, from vestiges of the lingual duct, and with far greater probability from the glands lying subjacent to the mucous membrane covering the posterior third of the dorsum of the tongue. They may be readily removed.

Cysts of the tongue are mostly retention cysts of the mucous glands of the posterior third of the dorsum of the tongue. They may, however, occur elsewhere on the organ. They are rarely larger than a hazel nut, are well-defined, spherical, tense, fluctuating, and they may be translucent. They are painless, of slow growth, and contain a clear, gelatinous fluid. The best treatment for such cystic tumours is to dissect them out; when, however, this cannot be accomplished, incision with the application of nitrate of silver to the interior of the cyst wall will usually suffice to effect a cure.

Blood cysts (exclusive of cavernous angioma) and cysticercus cellulose are all but unknown in the tongue.

Echinococcus (hydatid) cyst, also very rare in the tongue, is a solitary small cyst. It requires incision and removal of its cyst wall and contents. Excision of the whole cyst is preferable, and can generally be accomplished without difficulty.

Lingual tonsil.—Before leaving the subject of benign tumours of the tongue reference must be made to hypertrophy of the lingual tonsil, which consists of masses of lymphoid tissue lying subjacent to the mucosa of the hindermost part of the dorsum of the tongue in front of the epiglottis and on either side of the middle glosso-epiglottidean fold of mucous membrane. These masses, which may attain to the size of an almond, are reddish in colour, are frequently to be found associated with chronic pharyngitis, and may readily be destroyed by the galvano-cautery. This hypertrophy of the lymphoid tissue is most frequently seen in adult females.

Malignant tumours of the tongue.—These are, unfortunately, more frequent than benign growths.

Sarcoma is exceedingly uncommon, very few instances having been recorded in the larger proportion of which the growth was of the round-celled type.

Lympho-sarcoma of the so-called lingual tonsil—i.e. the aggregation of lymphoid tissue situated under the mucosa covering the posterior third of the dorsum of the tongue—is decidedly less rare than sarcoma of the tongue substance itself.

Carcinoma.—Carcinoma of the tongue is one of the most frequent, and certainly one of the most terrible, forms of cancer to which the human body is liable. The tongue is probably the commonest seat of malignant disease in the male subject. One variety of carcinoma alone affects the tongue—namely, the squamous epithelioma. This disease is all but unknown before thirty years of age, infrequent between thirty and forty years, distressingly common after forty years, especially so between forty and seventy, after which time the tendency to its development apparently decreases. The disease has greatly increased in frequency during the last quarter of a century. It commences in the vast majority of cases in some part of the anterior two-thirds of the organ, rarely originating in the posterior portion. It is far more frequent in men



Fig. 751.—Epithelioma of the Tongue, commencing as an indurated nodule opposite a rough carious tooth. Ulceration has as yet scarcely commenced. (From a patient at Charing Cross Hospital.)



Fig. 752. Ulcerated and Fissured Carcinoma of the Tongue. The organ cannot be protruded. (From Butlin.)

than in women, owing doubtless to the fact that smoking, spirit-drinking, and syphilis, inducing leucoplakia and other forms of chronic disease, are more common in the male sex. Irritation from any cause, especially when prolonged or oft-repeated (Fig. 751), tends to the development of epithelioma; hence the danger of irritating with caustics, especially in elderly people, any chronic morbid condition of the tongue.

Epithelioma usually commences on the margin or tip of the tongue, and may appear at first as a papillary growth, an ulcer, a crack, a nodule, or as a firm infiltrated lump. Much less frequently it is seen to originate on the dorsum or under surface of the organ. It always springs from epithelium; in the great majority of cases from

the normal covering of the tongue; much less frequently from the epithelium of the mucous glands of the organ. Probably, in about one case in three of lingual cancer, the history will reveal the existence of a benign epithelial growth or thickening—*e.g.* leucoplakia, ichthyosis—which, after having for years remained stationary or having increased but slowly in extent, has, under the influence of irritation,

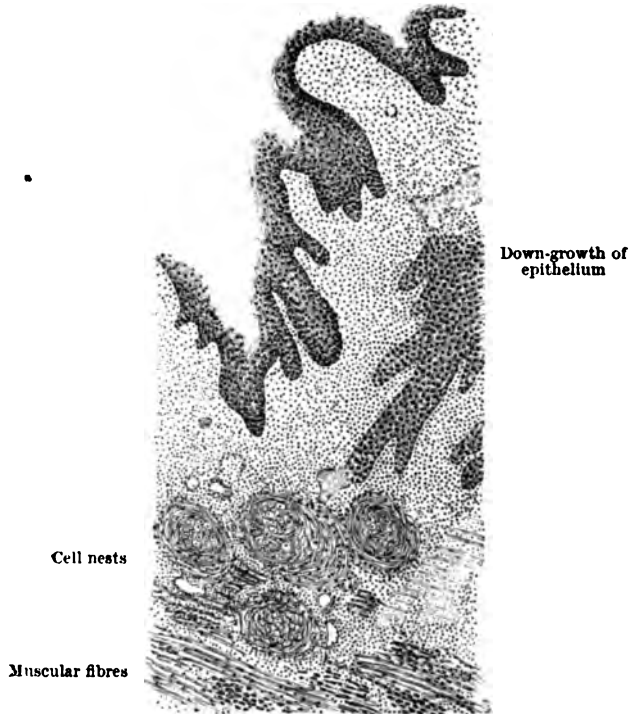


Fig. 753.—Microscopic Section of the Margin of an Epitheliomatous Ulcer of the Tongue, showing cell nests and epithelial down-growths. (From a section by Dr. C. J. Arkle.)

taken on malignant action. Hence it is that clinicians not infrequently refer to such conditions as “pre-cancerous.” It must be clearly understood, however, that only a certain number of cases of leucoplakia terminate in epithelioma, and that in the majority of instances of lingual epithelioma there has been no pre-existing leucoplakial condition.

Two characteristics of epitheliomatous growths are their proneness to early breaking down, which results in ulcer formation, and the induration which surrounds this ulcer from the period of its formation. Doubtless one of the chief reasons why lingual

epithelioma is so prone to early ulceration is that it of necessity suffers irritation from the movements of the tongue against the teeth, and the contact with food, condiments, and hot fluids.

Epitheliomatous ulceration, when fairly developed, presents distinct characteristics. The ulcer is irregular, deep, foul, sloughy, with raised nodular everted margins, and a surrounding zone of firm induration—this induration being the result of the down-growth of epithelial columns (Fig. 753) into the tissues, and of the inflammatory deposit of round cells caused by their presence.

More rarely do we find in epithelioma of the tongue ulceration for a time in abeyance, the growth then assuming a papillary character. In such a case the induration is also very slight in amount, and this fact leads sometimes to a mistaken diagnosis.

The increase in growth of lingual epithelioma is usually very rapid, life being destroyed in cases not submitted to operation, in the vast majority of instances in less than two years. Ten to eighteen months is, in such cases, the average duration of life after the first appearance of the growth; many cases, however, run a still more rapid course.

Severe pain often shooting up to the ear, foul blood-stained discharge, and an excessive flow of saliva are prominent symptoms. The lymphatic glands are early involved, the first to suffer being those in the submaxillary region of the same side as that on which the cancer is situated. It is of interest to note that sometimes the disease skips the nearest glands and involves more distant glands. This is by no means unusual, and such cases are of specially bad prognosis. Even when the epithelioma is quite small the glands may be distinctly infiltrated with new growth. In the early stages the glands are shotty and movable; later they become fixed, and tend to break down, to involve the skin, and to fungate. From these glands, which may become adherent to all the structures in the neighbourhood, the disease spreads to involve the lymphatic glands in the neck. Dissemination of the disease is not common, but the liver, lungs, kidneys, spleen, bone-marrow, subcutaneous tissue, etc., may show secondary deposits of malignant growth.

If unchecked by operation the growth extends rapidly, at first infiltrating the tissues in its immediate vicinity, and then causing them to break down. In this way the floor of the mouth, the lower jaw, the fauces, tonsils, epiglottis, and soft palate may be involved by the extension of the malignant ulceration.

The tongue is at first limited as regards its mobility by this infiltration, and later, may be rendered quite immobile and rigidly fixed, so that it cannot be protruded (Fig. 752). Speech and swallowing are thus much compromised, and the patient suffers chronic septic poisoning, caused by the foul discharge ever present in his mouth. Death usually now closes the scene of suffering, and is generally the result of exhaustion, the patient's strength being worn out by the constant pain, mental distress, chronic septic poisoning, and

white, or bluish-white from heaping up of thickened epithelium. The furrows may deepen into raw fissures, and the nodular masses of tissue bounded by them may become ulcerated, in consequence of their undergoing gummatous degeneration or as the result of local irritation.

In the advanced stage the tongue feels much harder than normal, and is divided up by furrows into pseudo-lobules (Fig. 749); the mucous membrane of the dorsum of the tongue is also firm and unyielding. All the above-described morbid conditions are chiefly seen on the dorsal aspect of the tongue.



Fig. 749.—Tertiary Syphilitic deep Sclerosis of the Tongue. The organ is enlarged, firm, and divided by septa into cuboidal pseudo-lobules. (From a patient at Charing Cross Hospital.)

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The deep gumma lies in the muscular substance of the tongue. It is usually solitary, but not infrequently two, three, or more may co-exist. It causes no pain, and owing to this fact may not be noticed for some little time by the patient. It is palpable to the surgeon as a hard, firm, roundish swelling, which (unless absorbed) increases in size, undergoes softening, and ultimately involving the mucosa, which in the early stages is normal in appearance and freely movable over the swelling, opens on the surface of the tongue, and becomes transformed into an ulcerating cavity with irregular, soft, undermined margins, and containing an adherent slough resembling in appearance wet wash leather.

A deep gumma is most frequently situated near the middle line and under the mucosa of the dorsum linguae. After a gummatous ulcer has persisted for some weeks (usually without treatment) there may develop a certain amount of induration (Fig. 750), thus simulating epithelioma. Under treatment a gumma even of large size may be entirely absorbed without leaving any mark of its presence. More frequently it opens on the surface of the tongue and leaves a depressed linear or star-shaped cicatrix.

The diagnosis is not difficult when the gumma has been observed from the time of its formation to that of its breaking down into an ulcer. Before breaking down it might be mistaken for any deep-seated tumour of the tongue or for chronic abscess; after the gumma has given place to the ulcer this might be confounded with tuberculous disease, primary chancre, or more importantly with epithelioma.

It may be mentioned that the gummatous ulcer has little or no tendency to increase in size, that it is, unless irritated, at the worst only slightly painful, and that the lymphatic glands are, as a rule, not involved. In cases of difficult diagnosis reliance must be placed on the history, on any co-existing morbid conditions, and on the presence of scars and other traces of former manifestations of the disease. Microscopical examinations of scrapings from the ulcer, or better of a small excised fragment, will frequently throw much light on a diagnosis previously obscure.

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of glossitis (both superficial and deep) are very resistant to treatment; usually little can be done for their relief.

Treatment of tertiary lingual syphilis.—Iodide of potassium is here our sheet anchor, and rarely fails to yield beneficial results in cases of gummata. It is frequently necessary to administer ample doses (gr. xx to xxx) thrice daily. Often it will be useful to give at the same



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Actinomycosis of the tongue.—This affection, almost unknown in England, is not so infrequently met with on the Continent. Out of twenty-one cases of actinomycosis in Albert's clinique, from 1882 to 1888, in four instances the tongue was affected (Tillmanns). The tongue may, of course, be involved, together with other parts in actinomycosis, or it alone may suffer in consequence of direct infection conveying the fungus from a prick with a straw, or husk of wheat, or oats, etc.

The diagnosis is made by microscopic examination. (See p. 314, Vol. I.)

Treatment.—Removal as complete as possible of the focus of infection, either by excision or very free scraping, followed by cauterisation with the thermo-cautery.

Innocent tumours of the tongue.—Tumours of the tongue are divided into innocent and malignant. Innocent tumours occur less frequently than do malignant new growths. Many varieties of benign tumours affect the tongue. Every one is, however, somewhat rare, many are extremely rare.

Nævus is probably the most frequent of the innocent tumours of the tongue. Three varieties of nævus are usually described—capillary, venous, and arterial. It must be borne in mind, however, that most frequently two of these elements are combined. Thus an arterial nævus consists partly of capillaries; and the same is true of venous angiomas. Angiomas are, perhaps, best divided into simple angiomas, which consist of dilated and newly-formed vessels; and cavernous angiomas, which are built up of distinct cavities lined by endothelium, and containing blood. (See p. 580, Vol. I.)

The common veno-capillary nævus is bluish; the much rarer arterio-capillary is bright red in colour. Nævi of the tongue very rarely exceed an inch in diameter. They are usually congenital, and may disappear spontaneously. They are generally situated either just under the mucous membrane of the dorsum of the tongue or deep in the substance of the organ. In this latter situation they are almost always cavernous. Nævi may be single or multiple. In many cases the nævus can be emptied by pressure; in other cases this cannot be done, the growth then feeling cystic. The swelling is painless, and, when small, causes very little inconvenience. When

Large, it is troublesome only by reason of its size. Over the sub-mucous nævi the mucosa is thinned, and contains numerous small varicose vessels, which aid materially in the diagnosis.

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The best treatment is cutting them off with scissors or knife under cocaine. Should the hæmorrhage be severe, it can be stopped by the application of the galvano-cautery at a dull red heat.

Lipomata occur rarely on the tongue. The growth of a lingual fatty tumour is very slow. The swelling may distinctly give the feeling of fluctuation, and be mistaken for cyst or abscess. If causing inconvenience by its size, it can readily be enucleated by a linear incision made over it, as it is always encapsulated.

Fibromata not quite so rarely as lipomata occur on the tongue. They are usually very soft, and may be multiple. Not infrequently they present themselves as soft polypoidal growths on the dorsum.

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Cysts of the tongue are mostly retention cysts of the mucous glands of the posterior third of the dorsum of the tongue. They may, however, occur elsewhere on the organ. They are rarely larger than a hazel nut, are well-defined, spherical, tense, fluctuating, and they may be translucent. They are painless, of slow growth, and contain a clear, gelatinous fluid. The best treatment for such cystic tumours is to dissect them out; when, however, this cannot be accomplished, incision with the application of nitrate of silver to the interior of the cyst wall will usually suffice to effect a cure.

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Lympho-sarcoma of the so-called lingual tonsil—i.e. the aggregation of lymphoid tissue situated under the mucosa covering the posterior third of the dorsum of the tongue—is decidedly less rare than sarcoma of the tongue substance itself.

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the normal covering of the tongue; much less frequently from the epithelium of the mucous glands of the organ. Probably, in about one case in three of lingual cancer, the history will reveal the existence of a benign epithelial growth or thickening—*e.g.* leucoplakia or ichthyosis—which, after having for years remained stationary or having increased but slowly in extent, has, under the influence of irritation

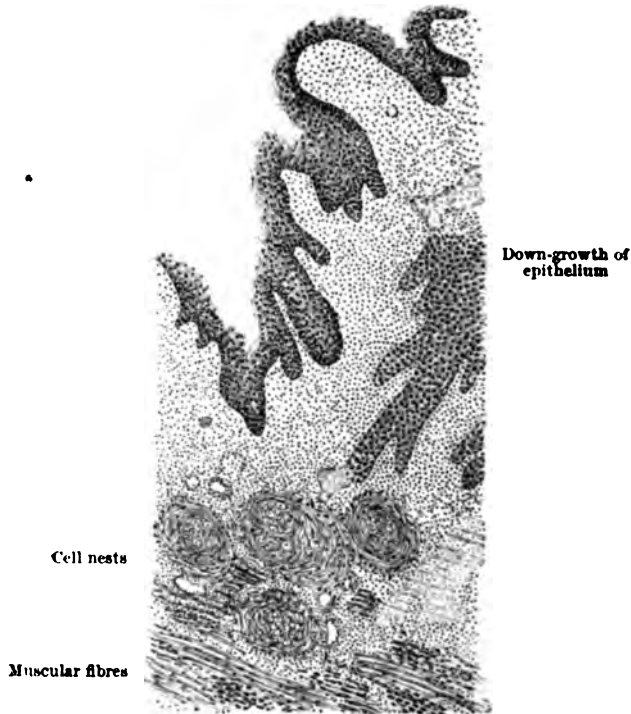


Fig. 753.—Microscopic Section of the Margin of an Epitheliomatous Ulcer of the Tongue, showing cell nests and epithelial down-growths. (From a section by Dr. C. J. Arkle.)

taken on malignant action. Hence it is that clinicians not infrequently refer to such conditions as “pre-cancerous.” It must be clearly understood, however, that only a certain number of cases of leucoplakia terminate in epithelioma, and that in the majority of instances of lingual epithelioma there has been no pre-existing leucoplakial condition.

Two characteristics of epitheliomatous growths are their proneness to early breaking down, which results in ulcer formation, and the induration which surrounds this ulcer from the period of its formation. Doubtless one of the chief reasons why lingual

epithelioma is so prone to early ulceration is that it of necessity suffers irritation from the movements of the tongue against the teeth, and the contact with food, condiments, and hot fluids.

Epitheliomatous ulceration, when fairly developed, presents distinct characteristics. The ulcer is irregular, deep, foul, sloughy, with raised nodular everted margins, and a surrounding zone of firm induration—this induration being the result of the down-growth of epithelial columns (Fig. 753) into the tissues, and of the inflammatory deposit of round cells caused by their presence.

More rarely do we find in epithelioma of the tongue ulceration for a time in abeyance, the growth then assuming a papillary character. In such a case the induration is also very slight in amount, and this fact leads sometimes to a mistaken diagnosis.

The increase in growth of lingual epithelioma is usually very rapid, life being destroyed in cases not submitted to operation, in the vast majority of instances in less than two years. Ten to eighteen months is, in such cases, the average duration of life after the first appearance of the growth; many cases, however, run a still more rapid course.

Severe pain often shooting up to the ear, foul blood-stained discharge, and an excessive flow of saliva are prominent symptoms. The lymphatic glands are early involved, the first to suffer being those in the submaxillary region of the same side as that on which the cancer is situated. It is of interest to note that sometimes the disease skips the nearest glands and involves more distant glands. This is by no means unusual, and such cases are of specially bad prognosis. Even when the epithelioma is quite small the glands may be distinctly infiltrated with new growth. In the early stages the glands are shotty and movable; later they become fixed, and tend to break down, to involve the skin, and to fungate. From these glands, which may become adherent to all the structures in the neighbourhood, the disease spreads to involve the lymphatic glands in the neck. Dissemination of the disease is not common, but the liver, lungs, kidneys, spleen, bone-marrow, subcutaneous tissue, etc., may show secondary deposits of malignant growth.

If unchecked by operation the growth extends rapidly, at first infiltrating the tissues in its immediate vicinity, and then causing them to break down. In this way the floor of the mouth, the lower jaw, the fauces, tonsils, epiglottis, and soft palate may be involved by the extension of the malignant ulceration.

The tongue is at first limited as regards its mobility by this infiltration, and later, may be rendered quite immobile and rigidly fixed, so that it cannot be protruded (Fig. 752). Speech and swallowing are thus much compromised, and the patient suffers chronic septic poisoning, caused by the foul discharge ever present in his mouth. Death usually now closes the scene of suffering, and is generally the result of exhaustion, the patient's strength being worn out by the constant pain, mental distress, chronic septic poisoning, and

insufficiency of nourishment and sleep. Less frequently septic pneumonia, due to minute germ-laden fragments of growth and of slough from the ulcerated surface gaining entrance into the lungs during inspiration, occasions the fatal result. In other cases a profuse hæmorrhage, due to the ulceration eating into the lingual artery or other large vessel in the neck, may cause sudden death; more commonly repeated small hæmorrhages occur, which rapidly exhaust the patient's strength. Rarely is death the result of suffocation, which may be brought about by the pressure of the mass of enlarged glands on the trachea.

The **diagnosis** of lingual carcinoma is in well-marked cases easy. In the early stages certainty of diagnosis may be difficult of attainment. Conditions which may be mistaken for epithelioma are—syphilitic gummata; syphilitic ulcers, primary or tertiary (very seldom secondary); tuberculous ulceration; innocent epithelial growths, as papilloma or epithelial thickenings and overgrowths, due to chronic irritation, as leucoplakia; simple ulcers that have lasted for some time, as indurated dental ulcer. The difficulty of diagnosis is rendered the greater by the fact that many of the above may undergo carcinomatous change. It is to be clearly understood that a distinct history of a syphilitic infection by no means negatives the diagnosis of epithelioma.

Syphilis may, and often does, co-exist with epithelioma; thus a gummatous ulcer may become epitheliomatous, or the same may occur to a leucoplakial patch that owes its origin to syphilis.

Attention may be called to a few distinguishing features that will aid in the differential diagnosis:—

Primary chancre will probably occur in young people, it will be situated near the tip of the tongue; the glands will be affected very early, and symptoms of secondary syphilis will soon appear.

Non-ulcerated gumma, as Butlin points out, can only be confused with that form of cancer in which the disease begins as a lump or nodule in the parts beneath the mucous membrane.

In both diseases the situation is usually on the dorsum, the mass is slow in its growth, the glands are as yet unaffected, and the swelling is hard, and apparently infiltrates the tissues of the organ. Iodide of potassium in large doses up to gr. xv to gr. xxx thrice daily will speedily cause the gumma to vanish. The diagnosis may be assisted if there are syphilitic cicatrices or other marks of the disease present on the body. If there are two or more tumours, the diagnosis is almost certainly gumma, as two carcinomata occur in the tongue simultaneously only with exceeding rarity, while gummata are frequently multiple.

The chief difficulty in diagnosis is between epithelioma and gummatous ulcer of the tongue. The table given below attempts to bring out the points of difference between the two:—

EPITHELIOMATOUS ULCER.	GUMMATOUS ULCER.
Patient over forty.	Patient may be much younger.
Often there is present some distinct cause of local irritation.	None.
More often situated on margin of tongue.	More often near median line of tongue.
Edges of ulcer raised, firm, nodular, and everted.	Edges softer and undermined.
Base irregular and tuberculated.	Base often covered by wash-leather-like slough.
Very rarely more than one ulcer.	Ulcers often multiple.
Induration follows ulceration.	Induration precedes ulceration.
Lymphatic glands always involved if ulcer has lasted some weeks.	Lymphatic glands very rarely involved.
There is frequently no history of syphilis.	Syphilitic history obtainable.
Frequently some chronic epithelial thickening— <i>e.g.</i> leucoplakia, precedes ulcer, or is situated on other parts of tongue.	Usually none such present.
Begins on surface of tongue.	Begins in substance of the tongue— <i>i.e.</i> under the mucosa.
Ulcer at first superficial.	Ulcer cavity deep from commencement.
Secretion from ulcer foul and free.	Secretion less foul and smaller in amount.
Irregular shape.	Roundish shape.
Tongue immobile (in later stages).	Tongue freely movable.
Speech and swallowing rendered difficult.	Speech and swallowing little affected.
Grows rapidly.	Remains quiescent.
Cancerous cachexia (in later stages).	No cachexia.
Pain extreme, shooting towards ear.	Painless or only very slightly painful.
Anti-syphilitic treatment has no effect (or only a slight temporarily beneficial result); ulcer increases in size under its employment.	Anti-syphilitic treatment soon curative.

The differential diagnosis of tuberculous and epitheliomatous ulcers can scarcely cause much difficulty, for primary tuberculous ulceration of the tongue is one of the rarities of surgery; and in secondary tuberculous ulceration there are generally manifest signs of the same disease in lung, larynx, or other parts. Should a primary tuberculous ulcer be excised under the mistaken view that it is malignant, the surgeon may rest satisfied that the best treatment for the condition has been carried out.

Warty growths, epithelial thickenings, and simple ulceration may be diagnosable only with great difficulty from epithelioma of the tongue when they approach the stage of transition from innocent into malignant growths. The most reliable signs that such a change is taking place are, in addition to the ulceration, fixation and induration, in the presence of which no time should be lost in freely removing the growth.

In all cases where serious doubt exists, a tiny portion of the

margin of the ulcer should be excised under cocaine and submitted to microscopic examination. Less certain, but still very valuable, is the method, the employment of which we owe to the advocacy of Butlin, of examining microscopically the scrapings from the ulcer.

In tertiary syphilitic ulcers iodide of potassium works wonders in a short time; but it is an undoubted fact that not infrequently in cases which are distinctly malignant, temporary improvement, manifested by diminution of pain, fœtor, and discharge, occurs for a few days under the free administration of this drug. This deceptive improvement, however, is in such cases not maintained, and henceforth the iodide has no further influence on the disease.

The surgeon must be mindful of this transient action of the iodide, otherwise he may readily be induced to give far too favourable a forecast to the patient. I cannot too forcibly urge that the diagnosis in all cases ought to be made at the earliest possible moment, and before lymphatic glandular involvement, perceptible to the examining fingers, has occurred. It should be borne in mind that the large majority of doubtful cases prove later to be malignant, and that it is unjustifiable to wait for obvious glandular implication to render the diagnosis certain. A tiny fragment, examined microscopically, will always give clear information as to whether the condition is epitheliomatous or not.

Treatment of cancer of the tongue.—Early removal of the disease is the great desideratum, and holds out to the patient the only hope of permanent relief. Operative treatment should be adopted in all cases in which the surgeon considers it practicable to remove the entire disease, *i.e.* both the primary growth and the secondary glandular involvements. Even when no enlarged glands can be felt, it is a good practice if the cancer has been in existence for some weeks to dissect out the neighbouring lymphatic glands. In fact, in the great majority of such cases it will be found on microscopic examination of the glands that infection has already occurred. It may be laid down as a general rule of surgery that involvement of lymphatic glands in cancer usually proves after division of the deep fascia to be more extensive than the surgeon was led to believe from examination over the unbroken skin.

When the disease is in an advanced stage the question of the propriety of operative treatment becomes more doubtful, and cases which one surgeon would operate upon without hesitation, another of equal experience would decline to interfere with. The surgeon should, however, always bear in mind that in cases of lingual cancer which are not submitted to operative treatment death terminates a time of terrible suffering and misery, and that though excision of the tongue may not appreciably lengthen the span of life (it usually does so, however, to the extent of a few months), still death from secondary glandular disease after removal of the organ is immeasurably more tolerable. There is no sight more pitiable than that of a patient tortured with the agonies of lingual epithelioma, with its unceasing pain in mouth and ear, its fœtid discharge which gradually

poisons, and its copious salivation, which constantly distresses the sufferer. Death from glandular involvement (the primary growth having been extirpated) is, compared with this distressing state, comparatively painless, and the knowledge of this fact should induce the surgeon to remove, whenever possible, the primary disease (in the tongue), in order to diminish suffering, even if life cannot be prolonged.

It is, therefore, good surgery to narrow as far as practicable the contra-indications to operation. Still, there are limits beyond which the judicious operator will not travel, except perhaps at the urgent desire of the patient, to whom the state of affairs has been made clear.

If the cancer has extensively involved the fauces, soft palate, or the floor of the mouth; if the tongue is rigidly adherent to the jaw and floor of the mouth; if the glands under the sterno-mastoid are extensively involved, especially on both sides; if the patient is too exhausted by the cancer or by other intercurrent disease to stand the shock of the necessarily severe operation, the surgeon may be compelled to admit that the time for operation has passed.

If the whole of the disease can be removed—that is, if there is only slight involvement of the floor of the mouth, or of the glands in the submaxillary region, or some amount of adhesion to the jaw, or slight extension of the disease to the pillars of the fauces on one side—the operation should always be attempted.

In cases which are clearly inoperable the treatment can only be palliative. Cocaine in 2 per cent. solution may be freely painted on the ulcerated surface, especially just before the administration of food, which must always be bland, nutritious, and fluid. Morphine may be employed in a similar manner, but the chief use of this drug is for internal administration by the mouth or by hypodermic injection in large and necessarily increasing doses to allay the terrible suffering caused by the disease, and to give rest to the worn-out patient. An antiseptic mouth-wash of 1 to 200 of carbolic acid, or a solution of chlorate of potash (3j to the 3vj of water), will relieve the fœtor, or iodoform containing a small amount of morphine may be dusted on the ulcer with the same object.

Division, or better, neurectomy of the lingual nerve, which can be reached from the buccal cavity, just below the last molar tooth of the lower jaw, when the tongue is drawn out of the mouth and towards the opposite side, or cauterisation of the ulcer itself to destroy, as far as possible, the nerve endings, or ligature of the lingual artery, in the hope that it may retard the growth of the cancer, are severally recommended as palliative operations.

The value of the last mentioned is dubious; the second method leaves a foul slough, and often fails in its object. If any of the three be employed, the preference should certainly be given to excision of a portion (as long as possible) of the lingual nerve, a procedure which is easy of performance, and certain to afford at least a temporary relief from suffering.

Excision of the tongue.—Very various methods of removing

the tongue have been advocated—the knife, the thermo-cautery, and the *ecraseur* all have their adherents; but the operation as performed by Whitehead by means of the scissors is rapidly superseding all other methods, and is certainly the preferable procedure. Removal of the tongue may be total or partial. When operating for cancer it is in the majority of instances wiser to remove the whole organ.

Innocent growths will, of course, be excised with only a small portion of the organ in their immediate vicinity. Their removal is easily performed by the employment of scissors or the knife. The margins of the wound in the tongue can then be accurately sutured. Primary union is thus usually obtained.

When an epithelioma is of small size and of recent growth, and is situated on or near the tip of the tongue, many surgeons remove more or less only of the anterior portion of the tongue. In general this is not to be recommended, for however small and recent the epithelioma, extirpation of the lymphatic glands nearest to the diseased area should also be performed. It may here be mentioned that the lymphatic vessels of the tongue run in company with the ranine vein, and enter the lingual glands (three or four small lymphatic glands situated on the superficial aspect of the *hyo-glossus* muscle), whence they pass to the group of deep cervical glands in the neighbourhood of the bifurcation of the common carotid artery. The lymphatics, from the floor of the mouth and from part of the most anterior portion of the tongue, enter the submaxillary lymphatic glands.

Removal of one (lateral) half of the tongue is not, as a rule, to be advised, even though the growth be situated at the margin of the tongue. The risk to life is not less than in the more extensive operation. The after trouble is even greater, and there is some tendency to recurrence of the disease in the half of the organ remaining, which is not movable but is bound down to the floor of the mouth by cicatricial adhesions, and is therefore useless for speech and swallowing.

The operation of excision of the tongue has a distinct *mortality*, probably not less than 10 per cent. The most frequent cause of death being septic pneumonia; it is therefore essential to render the mouth as little foul as possible before the operation is undertaken. Trouble spent upon cleansing the mouth with antiseptic solutions, and purifying the teeth and breath, is certainly not thrown away.

The main difficulty in the performance of the operation arises from the hæmorrhage; this may be obviated by preliminary ligation of the lingual arteries in the neck. All risk of blood passing into the air-passages, and causing immediate suffocation or later septic pneumonia, may be avoided by performing laryngotomy and packing the lower pharynx with a sponge. In the great majority of cases, however, a preliminary laryngotomy is certainly quite unnecessary.

Ligation of the lingual arteries makes the excision of the tongue comparatively a bloodless operation, and by means of the incisions

for exposing the arteries, infected lingual or submaxillary lymphatic glands may be removed. I am convinced that it adds much to the comfort of the patient to remove at the same time the submaxillary salivary glands, in order to diminish the excessive salivation. Another argument in favour of their removal is the fact that ranula not very infrequently follows extirpation of the tongue, owing doubtless to injury to or involvement in cicatricial tissue of Wharton's duct.

Three methods of excising the tongue may here be briefly alluded to. For other procedures reference should be made to a manual of operative surgery.

(i) *Whitehead's operation*.—In this the scissors are employed, by means of which the tongue is freed from its attachments to the jaw (especially the frænum linguæ) and to anterior pillars of the fauces, when it can be so freely drawn out of the mouth that the operation comes to be performed outside rather than inside the mouth. This position enables the organ to be removed with greater ease and less danger. The tongue being now drawn forwards by the aid of a strong ligature passed through its tip, the muscular attachments of the organ are then divided rapidly with the scissors. The lingual arteries are secured as they are cut, or, preferably, just before section. The organ should be removed as near the epiglottis as possible. It is a wise precaution to pass a silk thread through the mucous membrane in front of the epiglottis (glosso-epiglottidean fold) and to bring its ends out of the mouth in order to be able to draw forwards the epiglottis and floor of the mouth, and thus secure the bleeding vessel in case of reactionary or secondary hæmorrhage occurring. A saturated solution of iodoform in ether may be now employed, or iodoform may be freely dusted on to the wounded surface. Should the surgeon determine to remove one-half of the tongue only, the organ is divided vertically in the middle line, when the diseased half can be removed in the manner above indicated.

(ii) Excision of the tongue, with preliminary ligature of the lingual arteries in the neck, is practically Whitehead's operation for removal of the tongue with scissors, rendered comparatively bloodless after the two great feeding arteries of the organ have been secured by ligature. This method of removal of the tongue is undoubtedly the best, as it has the great advantages that infected lymphatic glands may be removed through the incisions for ligature of the lingual arteries, and that owing to the very slight bleeding which occurs after ligature of the lingual arteries the excision of the tongue can be carried out with ease, rapidity, and entire freedom from anxiety on the part of the surgeon.

(iii) *Kocher's operation*, which is recommended only for cases in which the carcinoma has invaded the floor of the mouth and the jaw. This operation is preceded by tracheotomy, the pharynx is plugged with a sponge or with iodoform gauze, and the anæsthetic is administered through the tracheotomy tube. An incision is now made in the neck, which commence below the mastoid process, runs down along the anterior border of the sterno-mastoid muscle

to its mid point, thence courses forwards to the hyoid bone to the middle line, whence it is continued upwards to the symphysis of the lower jaw. The flap thus formed is turned forwards and upwards on to the cheek, the lingual and facial vessels are ligated, and the contents of the submaxillary fossa—namely, lymphatic glands, submaxillary and sublingual salivary glands—are cleared out. The lingual artery of the other side is now ligatured through a separate incision. The mylo-hyoid and mucous membrane close to the jaw are now divided, and the tongue drawn through the gap thus made is removed by galvano-cautery or scissors. The external wound is not sutured; the whole gap and the mouth are plugged with iodoform gauze. This dressing is changed twice daily, when the patient may be fed by a tube, or rectal feeding may be employed. The wound heals by granulation. There is no retention of putrid discharges, hence there is little liability to septic pneumonia or septicæmia.

After-treatment of cases of excision of the tongue.—The mouth cavity must be frequently washed out with an antiseptic solution, and painted with a solution of iodoform in ether, or dusted with powdered iodoform. Rectal feeding may be resorted to for the first two or three days; then the patient may be fed through a feeding-tube passed into his œsophagus, though in many cases this is not necessary.

Results of excision of the tongue.—The immediate results are satisfactory. The mortality, chiefly from septic pneumonia, hæmorrhage, pyæmia, septicæmia, shock, and exhaustion, is about 10 per cent. In the greater number of fatal cases the disease has extended beyond the tongue to jaw, floor of mouth, fauces, etc. Recurrence of the disease in lymphatic glands—more rarely in the stump—within a year of the operation is unfortunately the rule (90 per cent. of cases). In certain instances, however, freedom from recurrence has been observed five or more years after operation. A permanent cure is very rarely met with. It will thus be seen that the condition is one of the most deadly forms of malignant disease. All that can be hoped for from operative treatment as regards prolongation of life is, in the great majority of cases, not longer than from six to nine months. Of far greater importance, however, is the fact that by operation the pain and discomfort of the patient are minimised almost beyond conception, and the due appreciation of this fact will be the surgeon's justification in urging operation, even when a considerable prolongation of life cannot be looked for.

AFFECTIONS OF THE PALATE, FAUCES, TONSILS, AND PHARYNX.

AFFECTIONS OF THE PALATE.

It must be remembered that the palate is represented by an anterior portion, the hard palate, consisting of bone and muco-periosteum, and a posterior part of the soft palate, composed of muscles lying

between two layers of mucous membrane. These two parts, unlike in their structure and function, differ essentially in their pathology, the soft palate sharing to a greater or less extent in the affections of the tonsils and pharynx, the hard palate not being involved by such.

Among affections of the hard palate may be noticed abscess, tuberculous and syphilitic lesions.

Abscess of the hard palate.—This may be seen in connection with tuberculous and syphilitic disease of the bone. It is often observed as a result of dental caries, leading to peri-odontitis, in which case the small abscess will be found just within the alveolar arch. A swelling commences here, which is at first firm. It rapidly softens, bursts, and gives vent to a small quantity of pus. Healing soon occurs, unless there be some caries or necrosis of the alveolar border of the jaw. Attention must be directed to the dental lesion which occasioned the abscess formation, otherwise recurrence may be anticipated. Early incision of the abscess is to be employed.

Syphilitic disease of the hard and soft palate.—Syphilis may affect the palate either as a secondary or a tertiary lesion.

The **secondary lesions** are limited to the mucous surface, and consist of (1) erythema, especially marked at the faucial extremity of the soft palate, the cause of the sore throat, one of the earliest and most typical signs of secondary syphilis; (2) mucous patches, which are frequently seen on the soft palate, and which, in consequence of being subjected to irritation, may become superficially ulcerated. These small ulcers present a surrounding zone of congestion, and may become confluent, giving rise to a marked but fortunately usually superficial form of ulceration, which may prove resistant to treatment. For such secondary syphilitic lesions mercury must be given internally, and when ulceration has supervened, painting the surface with a solution (1 to 400) of corrosive sublimate will be found to yield the most satisfactory result.

Tertiary syphilis of the palate is a far more serious lesion, generally involving the bone. Small firm gummata the size of an almond, or larger, are found in the hard or soft palate. These may commence in the periosteum of the palate, but frequently take origin in the floor of the nose, from which they pass downwards, destroying in their course the bony roof of the palate. In the soft palate they may arise in the submucosa. More rarely are seen gummata of the muscular substance. Gummata of the palate are situated usually in the middle line (Fig. 754), and are thus distinguished from abscess due to dental causes. They are most common towards the hinder part of the hard palate or fore part of the soft palate. Under treatment such gummata may disappear. More frequently, however, they break down, perforate the palate, and leave typical gummatous ulcers. When the hard palate is involved there is usually more or less necrosis, which leads to perforation (Fig. 754), through which food and fluid may pass into the nasal chambers, and the patient acquires the distinct nasal twang of voice. This necrosis of the palate may be the result of the acquired or of

the hereditary form of the disease. In the latter case it usually makes its appearance from the tenth to the twenty-fifth year of life.

In certain cases of syphilitic (or tuberculous) ulceration affecting both soft palate and pharynx, when healing of the ulceration results, there may be organic union between the two. Thus the soft palate may be firmly adherent in part to the posterior wall of the pharynx, and the cavity of the mouth be more or less completely shut off from the nasal chambers. Respiration through the nose is thus rendered difficult or impossible, and the effect on speech is striking.

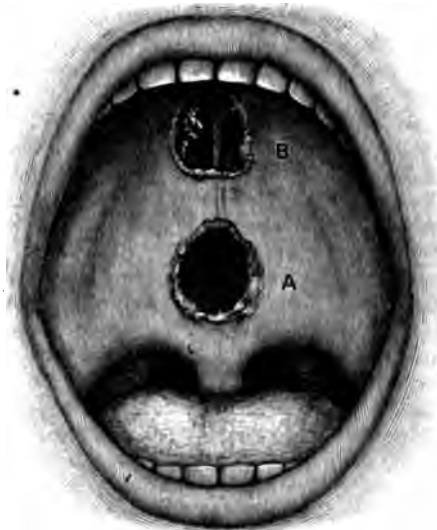


Fig. 754.—Gummatous Ulceration with Perforation of the Hard and Soft Palate. The two ulcers occurred in the same patient—a woman of twenty-five years of age—but an interval of four months existed between the appearance of each. The perforation of the soft palate healed entirely under iodide of potassium. The perforation in the hard palate shows a spicule of bone which is dead and loose. This aperture diminished in size, but a round foramen persisted, necessitating the employment of an obturator to prevent the passage of food into the nose and to render speech distinct.

A, Perforation in soft palate; B (from a patient at Charing Cross Hospital), perforation in hard palate.

Treatment of tertiary syphilis of the palate.—Iodide of potassium in large doses (gr. x to gr. xxv thrice daily) must be given upon the first appearance of the gumma. Its effect is eminently satisfactory, though frequently the surgeon does not see the patient until necrosis has occurred, in which case, however, the gummatous ulceration will usually begin to heal as soon as the iodide is administered. The gumma when it is breaking down often resembles an abscess, and the surgeon is therefore tempted to incise the swelling. This is to be avoided, as it allows of the entrance of pyogenic cocci from the mouth (where they normally exist in abundance), and for the further reason that we now know that such gummata have often their starting-point in the floor of the nose. When necrosis has occurred, and

a somewhat large perforation exists, the surgeon may advise the use of an obturator; but in the majority of cases much may be done to contract the orifice. Frequently a cure may be obtained by a plastic operation, of which I have found a modification of Davies Colley's method for cleft palate to yield excellent results. For the success of such an undertaking it is essential that all ulcerative action must have ceased for some weeks before operative treatment is undertaken.

Tuberculosis of the palate.—Tuberculous disease does not frequently attack the palate, and, even when present, is very rarely localised primarily in this part. Most cases of palatal tuberculosis are found in association with a similar disease of the larynx, tongue, or lungs, or with lupus of the face or nose. In the *soft palate* the process, as a rule, starts as a uniform thickening in the mucosa or submucosa; later is found a deposit of tubercles, varying in size from miliary growths to masses as large as a small cherry-stone. Such growths break down into ulcers, a number of which may coalesce and give rise to an extensive ulcerated surface. Between the ulcers are to be seen small miliary nodules. A less frequent form is that in which distinct nodules, which may attain to the size of a hazel nut, and over which the mucosa is much stretched, appear to caseate, and then break down into ulcers. This latter form is, if at all painful, far less so than the former, in which, certainly when the stage of ulceration has been reached, the pain is often very severe.

In the *hard palate* the above forms may rarely be encountered; more frequently we find tuberculous disease of the bone, which is often very difficult to distinguish from syphilitic disease, especially in children.

Perforation, as the result of tuberculous disease of the soft palate, is decidedly rare, though much deformity often results from ulceration and subsequent cicatricial contraction. In the hard palate the production of a perforation is the rule, though the progress is here far less rapid than in syphilitic disease.

In tuberculosis of the palate (the same holds good with respect to the pharynx) involvement of the lymphatic glands in the neighbourhood is the rule; it is quite exceptional in syphilitic disease.

The *prognosis* of palatal tuberculosis is dependent on the co-existence or absence of similar disease elsewhere. In the rare primary manifestations of the disease it is fairly favourable. In the more frequent secondary cases, the prognosis, as in tuberculosis of the tongue, depends, in a large measure, upon the extent of the disease elsewhere, especially in the larynx and lungs. As a rule it is unfavourable.

Treatment must be general and local. The general treatment is such as is to be recommended in all tuberculous affections—cod-liver oil, maltine, tonics containing iron, with strychnine, quinine, bracing climate, good food, etc.

Locally, lactic acid may be painted on the ulcerated surface

daily, in solutions varying from 25 to 75 per cent. Menthol in a 25 per cent. solution in olive oil may be used alone or as a preliminary application to deaden the pain produced by the lactic acid. When the disease is widespread, and involves palate, tonsils, fauces, and pharynx, direct surgical interference can do little good. When, however, it is distinctly localised, scraping with a small sharp spoon, with subsequent free application of the galvano-cautery, will be indicated. Iodoform may then be dusted on, and its continued use, or the employment of lactic acid or menthol, may in favourable cases effect a cure.



Fig. 755.—Epithelioma of Soft Palate, extending to tonsil and alveolar margin behind last molar tooth. (From a case at Charing Cross Hospital.)

Tumours of the palate.—These are not infrequent. New growths in this region are more often of a mixed variety than pure. **Sarcomata** and **epitheliomata** (Fig. 755) occur here, and demand free and early removal. Local recurrence, however, in sarcoma is unfortunately the rule, and glandular involvement in epithelioma occurs very early. Sarcoma of the palate is three times more common than epithelioma.

Adenomata of the palate occur rarely as pure adenomata; more frequently we find adeno-fibromata, adeno-myxomata (Fig. 756), and adeno-chondromata. They are of slower growth than the sarcomata, with which they may be confounded; they are usually distinctly encapsuled, shell out of the palate easily, and have no tendency to recur. They are more common in the soft than in the hard palate, and should always be removed.

Nævi, usually venous or veno-capillary, are more often seen on the hard than on the soft palate; multiple puncture with the galvanocautery at a dull red heat will be found the most satisfactory method of dealing with these growths.

Cysts may be met with on the palate; most frequently they are simple mucous cysts, resembling those described as occurring on the lip, and require the same treatment. Very rarely cysts containing sebaceous material are seen. They are probably dermoids, and owe their origin to inclusion of a portion of epithelium during fusion of

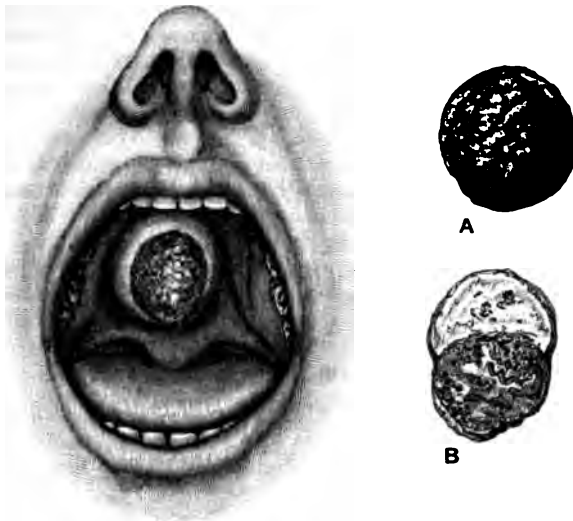


Fig. 756.—Adeno-myxoma of Palate. Tumour partially extruded. (From a case at Charing Cross Hospital.)

A, Tumour after removal, seen from the front; B, vertical section through tumour, the dark shading representing portion of tumour partially strangulated by ring of mucous membrane.

the embryonic palatal processes; from some irregularity in the same fusion arise more frequently the so-called palatine epithelial pearls—small bodies composed of accumulations of epithelium, hanging by slender stalks from the middle line of the roof of the mouth. They are not rare in infants.

Other tumours, such as lipoma, fibroma, myxoma, and chondroma are exceedingly rare, except when found in combination with other tissues, forming mixed tumours, as adeno-fibroma, chondrosarcoma, myxo-sarcoma, etc.

Before leaving the subject of palatal swellings, mention must be made of *aneurysms* of the posterior palatine artery, which are usually due to traumatism, and of the fact that *meningocoeles* may be found projecting through the median line of the palate.

AFFECTIONS OF THE UVULA.

Acute inflammation of the uvula.—This is usually found in association with acute catarrh of the pharynx. The uvula is swollen, acutely congested, and œdematous. Usually upon the subsidence of the pharyngeal catarrh the swollen uvula diminishes in bulk. If it does not do so, scarification, which gives exit to a considerable amount of blood-stained exudation, will rapidly be followed by the return of the uvula to its normal dimensions.

Elongation of the uvula may be due to chronic pharyngitis, to repeated attacks of acute inflammation, or it may be associated with adenoid vegetations and tonsillar hypertrophy. The abnormally long uvula gives rise, by coming in contact with the dorsum of the tongue, or even with the laryngeal mucosa, to reflex irritation, cough, and constant hawking.

In slight cases, astringents, such as glycerine of tannic acid, may be tried, but usually amputation of the uvula is demanded. The lower end of the structure should be seized with a vulsellum forceps, and cut off with scissors.

The hæmorrhage, which is but slight, is easily checked by sucking ice, and the wound heals after two or three days of somewhat acute pain. Cocaine may be employed as a local anæsthetic prior to amputation of the uvula.

AFFECTIONS OF THE TONSILS.

Acute inflammation of the tonsil.—Acute tonsillitis (angina tonsillaris) is always associated to a greater or less extent with acute pharyngitis; still, in the subject under discussion the tonsils bear the brunt of the inflammation.

Acute tonsillitis is usually seen between the ages of ten and twenty-five years; it is rare in children under five years of age. It may be due to various causes, important among which are—exposure to wet, cold, and bad hygienic conditions, such as sewer gas, rheumatism. The condition is far more frequent in the late summer and in autumn. At times distinct epidemics occur. There is little doubt that it is contagious; streptococci are commonly present in the inflamed part.

Symptoms.—The affection commences suddenly with a chill or slight rigor, high fever (up to 105°), headache, general malaise, aching in the limbs and back, thirst, offensive breath, foul tongue, constipation, pain referred to the region of the tonsil immensely aggravated by swallowing, and often shooting up towards the ear and to the side of the neck, with enlargement and tenderness of the cervical lymphatic glands. There is often much difficulty in opening the mouth, and, therefore, in many cases a sufficient examination of the affected parts is impossible; when the mouth can be widely opened, there is seen much redness and swelling of the palate, fauces, and tonsils, which last may nearly meet in the middle

line. Commonly, one tonsil is first involved, the other usually becoming affected within forty-eight hours; at other times both tonsils are simultaneously inflamed. Generally there are to be seen patches of creamy exudation, in which may be found shed epithelium cells, pus corpuscles, micro-organisms, granular *débris*, and fibrin; these accumulations may be observed exuding from the tonsillar crypts (lacunar tonsillitis), or they may be due to ulceration and pus formation in the follicles of the tonsil (follicular tonsillitis), as is usually found in tonsillitis due to septic causes. The inflammation terminates, as a rule, in resolution within a week from the commencement of the attack. An extreme amount of prostration out of proportion to the severity of the inflammation is frequently observed. Sometimes suppuration occurs, resulting in peritonsillar abscess.

When peritonsillar abscess—i.e. the formation of pus between tonsil and soft palate—occurs, the swelling of the tonsil (for it is usually on one side only) rapidly increases in size, the pain becomes much more marked, fluctuation can often be perceived, or more often there is a feeling of softening in one part of the anterior pillar of the fauces, which is bulged forwards. Unless relieved by incision, the abscess bursts externally, evacuation of pus giving marked and instantaneous relief.

Treatment.—In the earliest stages a smart purgative may be given. Tincture of aconite in small doses (mij) every half-hour until the pain and fever abate is often of much benefit in sthenic attacks. In cases due to rheumatism salicylate of sodium may be given in 20-grain doses every four or five hours until distinct relief from pain occurs. When the pain is severe a full dose of pulv. ipecac. co., 10 to 15 grains, at night time, yields beneficial results. Guaiacum in the form of 2-grain lozenges is valuable. Ice to suck, iced milk and soda, or meat jelly may be given. A solution (chlorate of potash, 3j to 3vj) may be employed as a mouth wash, gargling being too painful, and a cold compress round the neck will be grateful to the patient. In very painful rheumatic cases the throat may be painted or sprayed with cocaine, in order to allow of the taking of food. As soon as suppuration has occurred, or even is suspected, a puncture should be made through the anterior pillar of the palate just outside its margin. If pus be present, it is evacuated; if it has not formed, the local depletion will be most beneficial. A Gräfe cataract knife or pointed tenotome may be employed. If the knife be directed straight backwards, or backwards with a tendency inwards, there is no risk of injuring the internal carotid artery, the danger of which has been much exaggerated.

Chronic enlargement of tonsils (Fig. 757).—Hypertrophy of tonsils is very commonly seen in weakly children, most frequently between the ages of 8 and 15 years. It is usually the result of a chronic inflammation, less frequently is it a true hypertrophy of the glands. Repeated attacks of acute inflammation of the tonsils frequently result in their enlargement, and this condition itself tends to the

recurrence of the acute inflammation. Thus a vicious circle is established, under the influence of which the glands become progressively increased in size. This chronic enlargement of the tonsils is, in children, usually, and in cases where deafness is a prominent symptom, almost invariably, associated with the presence of post-nasal growths (adenoid vegetations).

The tonsils may be so much enlarged as to meet in the middle line, thus impeding respiration and deglutition. The crypts may be filled with foul-smelling decomposing secretion (Fig. 757), which imparts a very objectionable odour to the breath, perceptible to the patient

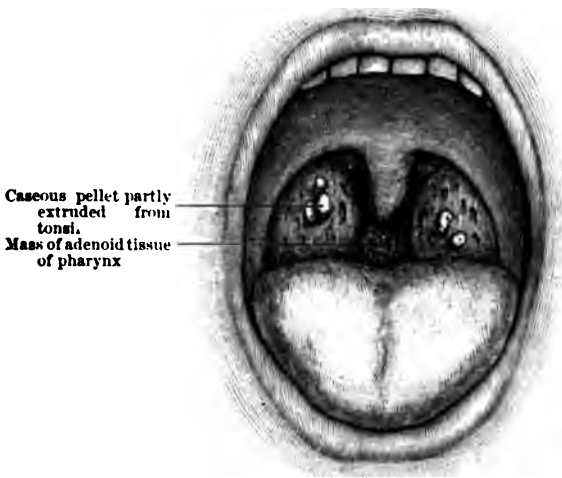


Fig. 757.—Chronic Enlargement of Tonsils. Caseous foul-smelling pellets are partially extruded from some of the crypts. On the posterior wall of the pharynx is seen a mass of hypertrophic adenoid tissue. (Victoria Hospital.)

himself. The hypertrophic condition of the tonsils is rarely seen to be present in a marked degree after the age of thirty years. There is an undoubted tendency to reduction in size after the full development of the individual has been attained.

Occasionally a calculus is found in the gland, the result of calcification of the contents of a crypt. Retention cysts and chronic abscesses are less frequently observed, and are difficult to differentiate one from another.

Symptoms.—The symptoms to which hypertrophy of the tonsils gives rise are referable to the size of the glands. In addition to impediment to the respiration and deglutition, there are interference with the movement of the palate, giving rise to a peculiar tone of voice, as if the child had a large bolus of food in the mouth; breathing with the mouth open; snoring during sleep, which is often

disturbed by terrifying dreams, and from which the child may awake struggling for breath; attacks of hawking and coughing; and repeated attacks of acute inflammation of the tonsils and chronic catarrh of the nose. Deafness may be caused by the catarrhal inflammation present in the acute or subacute exacerbations, spreading to the Eustachian tubes. Probably deformities of the chest wall (*e.g.* pigeon breast) may be caused by the difficulty in inspiration, especially when rickets is also present.

Treatment.—Slight forms of hypertrophy may be treated by painting with iodised glycerine (R. Iodi, gr. v; potassii iodidi, gr. xv; glycerine, ℥j), or with tincture of the perchloride of iron and glycerine with, in addition, the administration of cod-liver oil and tonics. In the form with decomposing pellets of fœtid secretion the crypts may be destroyed by the galvano-cautery, or a flat burner of the cautery may be applied to the surface of the tonsil. In the great majority of marked cases there is only one effectual method of treatment—amputation of the protruding part of the gland. This is best done with a tonsillotome, of which Reiner's and Ewens' instruments are useful forms. In certain cases where there is not so much growth inwards as in the antero-posterior or vertical direction, the tonsillotome cannot encircle the portion requiring amputation. In these cases a vulsellum forceps must be employed to seize the gland, and a probe-pointed bistoury used to amputate as much as is redundant. There is no need to remove the whole gland, which would be well nigh impossible, as that part which remains after amputation shrinks and cicatrises, so as almost to disappear from view under cover of the anterior pillar of the fauces. Before amputation the surface may be painted with a 10 per cent. solution of cocaine. The surgeon must never lose sight of the fact that when enlarged tonsils are seen there is every probability that adenoid vegetations are also present, and that these latter require removal even more urgently than the tonsils. I have frequently been struck by the fact that in cases where both conditions were present removal of the adenoid growths alone has caused entire relief from all unpleasant symptoms, though the enlarged tonsils remained untouched by operative interference.

Chancre of the tonsil is rarely met with. When it does occur, it is chiefly seen in women, and is frequently not correctly diagnosed, being mistaken for epithelioma or for acute inflammation of the tonsil. There is glandular enlargement, as in these two conditions, and more often than not the characteristic induration is absent. The appearance of secondary symptoms soon puts an end to all doubt as regards the diagnosis.

Tumours of the tonsil.—These are unfortunately more often malignant than benign.

Innocent tumours.—Among innocent tumours occur, in addition to retention cysts, fibromata, and very rarely tumours containing cartilage. A fibroma may reach the size of a hen's egg, and the symptoms it produces are referable solely to its bulk. Not very

infrequently fibrous tumours form distinctly pedunculated growths in the tonsil.

Treatment.—Pedunculated growths may readily be removed by cutting through the pedicle with scissors. Large non-pedunculated fibromata may be enucleated, usually with difficulty and severe hæmorrhage, and may require division of the anterior pillar of the fauces (Verneuil).

Malignant tumours.—Both sarcomata and carcinomata occur in the tonsil. *Sarcoma*, which is almost always a lympho-sarcoma, is the more common of the two. *Carcinoma* occurs as squamous epithelioma. The diagnosis between sarcoma and epithelioma cannot usually be made with certainty without microscopic examination. In both types there is the early involvement of neighbouring structures characteristic of malignant disease of the tonsil. The lymphatic glands are also soon affected, the ulceration is extensive, the foul-smelling discharge, and the rapid cachexia are alike. *Sarcoma*, as a rule, commences in the tonsil itself. In epithelioma the disease is rarely primarily tonsillar, but usually spreads from the palate, fauces, tongue, or pharynx.

Treatment.—Epithelioma can only very rarely be removed with any prospect of success, the cases suitable for operative treatment being those in which the malignant growth is early detected, and can be removed before glandular infection has occurred. *Sarcoma* is, though still of very bad prognosis, distinctly more amenable to treatment than epithelioma. It forms a projecting mass, with less tendency to early ulceration and infiltration of surrounding parts than epithelioma. In its earlier stages it is usually encapsulated, and may be shelled out from the mouth after division of the mucous membrane covering it with the thermo-cautery. The tendency to local recurrence is great, but distinctly less so than epithelioma. Should glandular involvement in the neck have already taken place (as is the rule), it will be wise to follow the example of Cheever, and remove the growth and affected glands by an external incision in the neck. In any case the prognosis of malignant growths of the tonsil is extremely bad, the disease extending in this situation with a rapidity and fatality unsurpassed in any other region of the body.

AFFECTIONS OF THE PHARYNX.

Acute inflammation of the pharynx.—Acute pharyngitis is usually associated, to a greater or less degree, with inflammation of the tonsils. It is commonly of a catarrhal nature, and the result of catching cold. It may owe its origin to scarlet fever, measles, small-pox, typhoid, to certain drugs, and to hot condiments, alcohol, and tobacco. It is very frequently met with in secondary syphilis. At times the condition appears to be of a distinctly contagious nature.

Symptoms.—In the acute form there is heat, tenderness, more or less pain on swallowing, with at first a dryness in the pharynx, followed by a muco-purulent secretion. The palate, tonsils, and

pharyngeal walls are congested, and not infrequently the uvula is swollen and œdematous.

The *treatment* is most simple. Steam inhalations, placing the feet in hot water, a dose of pulv. ipecac. co., gr. viij to xij, and a fomentation around the neck will suffice to cure the condition in a few days. The chief importance of this malady is that frequent attacks may give rise to the chronic form of pharyngitis, and that the acute condition in its commencement may be confounded with other far more dangerous maladies—diphtheria, scarlet fever, etc. It must be remembered that in an acute pharyngitis the inflammation may extend to the Eustachian tubes, causing their temporary occlusion and resulting deafness.

In adults, not infrequently acute pharyngitis supervenes on a pre-existing chronic inflammation, especially in heavy smokers and spirit drinkers.

Phlegmonous pharyngitis.—This is a most dangerous, though fortunately somewhat rare, form of acute pharyngitis. When occurring, it is generally the result of some severe injury; it may, however, occur without pre-existing trauma. It commences as an acute inflammation, much more severe and much more rapid than in the ordinary acute catarrhal inflammation.

The pharyngeal walls are deeply congested and œdematous, deglutition is impossible, the tissues of the neck are infiltrated and brawny, and the lymphatic glands are much inflamed. Laryngeal involvement early occurs, causing much dyspnoea, and may give rise to death from œdema glottidis. In other cases a fatal result is due to septicæmia or exhaustion.

The post-mortem appearances consist of intense, diffuse infiltration, with pus, of the mucosa and submucosa, and the changes characteristic of septicæmia.

Erysipelatous pharyngitis.—*Erysipelas* attacks the pharynx, commonly it is secondary to facial erysipelas; its symptoms are very similar to those above described in phlegmonous pharyngitis. Some authorities hold that the conditions are identical, but there is every reason to believe that they are distinct.

Erysipelas, though frequently fatal, is distinctly less formidable than phlegmonous inflammation.

Gangrene of the pharynx is rare. It may supervene on either of the above conditions, or may occur in syphilitic affections of the pharynx. Also it has been noticed as a result of diphtheria, scarlet fever, measles, typhoid, small-pox, or in weakly individuals it may be an extension of any ulceration of the pharynx. The gangrene may be patchy or involve a large area of tissue. In the patchy form recovery may ensue after separation of the necrotic tissue. In the more diffuse form symptoms of profound septic poisoning, great exhaustion and coma precede the inevitable fatal result.

Treatment of phlegmonous, erysipelatous, and gangrenous pharyngitis.—Inhalations of steam charged with some volatile antiseptic, carbolic acid, thymol, or eucalyptus may be employed.

Ice may be used to suck ; stimulants and meat-juice should be given by the mouth, and, where deglutition is impossible, nutriment and stimulants must be administered per rectum.

Pus must be evacuated if a distinct abscess forms.

Tracheotomy must be performed when indicated.

Treatment, however, is usually of little avail, the great majority of cases proving fatal.

Chronic inflammation of the pharynx.—Among other morbid conditions of the mucous membrane of the pharynx may be mentioned **chronic catarrhal pharyngitis**, in which there is a varying amount of congestion and swelling. This condition is very frequently seen in smokers, or as the result of errors in diet, or of repeated acute attacks of inflammation. Saline aperients in the morning, gargles of chlorate of potassium, with iodised glycerine or glycerine of tannic acid as a local application may be employed.

Hypertrophic or granular pharyngitis (clergyman's sore throat).—In this condition small red gelatinous granules are observed on the posterior wall of the pharynx. These granules are due to a hypertrophy of the lymphoid tissue of the pharynx. Thus they may be seen in childhood, usually in association with post-nasal vegetations (adenoid growths).

In many cases there is also present a lateral fold of thickened mucosa and submucosa which lies behind the posterior pillar of the fauces, and simulates a third pillar. To this condition the term lateral hypertrophic pharyngitis is applied.

In many cases presenting these peculiarities no symptoms are noticed ; in others, especially when the patient is in a weakened state of health, due to overwork, dyspepsia, or in women at the menopause, marked symptoms may be complained of, especially loss of voice, also a variety of morbid sensations in the pharynx, as heat, cough, slight pain, hawking, etc.

The loss of voice is very difficult to explain, but it is an undoubted fact that destruction of the lymphoid hypertrophic nodules frequently cures or alleviates this symptom in a remarkable way.

Treatment.—Restore the general health by tonics and change of scene when possible. Iodised glycerine, or glycerine of tannic acid and other astringent applications, in slight cases often prove beneficial. The most satisfactory result is, however, usually to be attained by destroying the granular hypertrophies with a bead of chromic acid fused on a probe, or, far preferably, by the employment of the electric cautery. This proceeding may be carried out after painting the surface with a 10 per cent. solution of cocaine.

Atrophic pharyngitis, or pharyngitis sicca, is a chronic condition in which the mucosa is thinned and smooth: there is deficient action of the mucous glands, the secretion from which dries into thin crusts. The only symptom from which the patient suffers is abnormal dryness of the throat. The local application of glycerine seems to give the best results. It may be applied as glycerine of boric acid, or glycerine may be diluted with an equal part of rose water.

Retro-pharyngeal abscess.—Retro-pharyngeal abscess is an infrequent but a most important and serious condition. It is an inflammation situated in the connective tissue, between the posterior wall of the pharynx and the bodies of the cervical vertebræ. The condition occurs in two entirely distinct types, as (1) an acute primary idiopathic, (2) as a chronic secondary tuberculous affection.

(1) **The acute primary idiopathic form** is usually met with in very young children, usually between the second and forty-eighth months of life. The inflammation may commence in the retro-pharyngeal connective tissue, as the result probably of the passage of pyogenic organisms through a minute abrasion or ulceration of the pharyngeal mucosa. More often it arises as a suppurative adenitis involving the lymphatic glands, lying in front of the upper cervical vertebræ, which are well developed in infancy, and atrophy before the period of second dentition commences. This lymphadenitis is usually the result of some affection of the mucous membrane of the pharynx or naso-pharynx, or even of the skin, such as eczema.

Tuberculous children are generally supposed to be specially liable to this affection, but it occurs, I am sure, as frequently in strong, healthy infants. The course of the inflammation is rapid; the child is uneasy, refuses to take food, its temperature is elevated, there is marked snoring at night, and regurgitation through the nose of any food that may be taken, the lymphatic glands in the neck are enlarged, and dyspnoea is marked, the child becoming cyanosed. Deglutition is now impossible. There is stridor and often a croupy cough.

The *diagnosis* is easily made by inspection and palpation when the posterior wall of the pharynx is seen bulged forwards, presenting a smooth elastic fluctuating swelling, which may often be felt from the outside of the neck, though covered here as a rule by enlarged tender lymphatic glands.

Treatment.—The abscess must be opened as early as possible. In young children where we have to do with this acute abscess, the swelling must be incised through the mouth with the head thrown forwards to prevent the escape of pus into the air-passages. The results of this treatment are exceedingly satisfactory. Unless operated upon, death from asphyxia occurs almost to a certainty, due either to the obstruction to respiration caused by the swelling or to the bursting of the abscess allowing pus to enter the air-passages.

(2) **The chronic secondary tuberculous variety** is always dependent on tuberculous disease of the bodies of the cervical vertebræ. The course of this condition is slow, and differs markedly from the acute form above described, there being no elevation of temperature, nor pain, nor any definite pharyngeal symptom. The stiffness and deformity of the neck precede the abscess formation, and render clear the diagnosis of the swelling. This condition is usually met with in children or young adults, rarely in infants; and as it is dependent on caries of the cervical vertebræ, the prognosis is

necessarily bad. The swelling can be seen and fluctuation readily made out from the mouth.

Treatment.—The abscess is frequently incised through the mouth as in the acute form. Here of necessity a septic condition arises, and the baneful effect of the mixed infection of pyogenic and tuberculous micro-organisms renders ultimate recovery very unlikely. Much better is it to follow the plan originally advocated by Hilton and Chiene, namely, to make an incision along the posterior border of the sterno-mastoid, then after incising the deep cervical fascia to draw forwards the great vessels, when the abscess cavity will be reached, and may be opened, and the orifice dilated by sinus forceps. The abscess cavity may then be drained, the carious portions of the vertebræ may be dealt with, and the whole proceeding conducted antiseptically. If this operation be carried out (and it is by no means so difficult as is usually imagined) the head and neck are to be fixed in some rigid apparatus, and with the use of rest, tonics and cod-liver oil a permanently good result may not infrequently be obtained. There is little doubt that incision through the mouth should be the method adopted in the acute cases; and incision through the neck the routine treatment in the chronic tuberculous retro-pharyngeal abscesses.

A **retro-pharyngeal gumma** is not infrequently seen, and is liable to be mistaken for abscess. It should be suspected when a supposed abscess is seen in an adult with no symptom of caries of the cervical vertebræ.

Ulceration of soft palate, fauces, tonsils, and pharynx.—Ulcerative conditions, as a rule, simultaneously affect several or all of these parts. It will, therefore, be convenient here to enumerate the various forms of ulceration which may be found in this region. We may describe—simple, gangrenous, syphilitic, tuberculous, and malignant ulceration.

Simple ulceration—ulcerated sore throat, or hospital sore throat—is the result, especially in debilitated subjects, of exposure to septic emanations from wounds, decaying organic matter, or sewer gas, or of overcrowding in a fœtid atmosphere. It is frequently seen in hospitals among the resident medical and nursing staff, especially in wards where there happen to be many patients with suppurating wounds; also it occurs frequently among students working in the dissecting and post-mortem rooms.

The *symptoms* are those of an acute inflammation of the mucous membrane of the pharynx, soft palate, tonsils, and especially of the fauces, with considerable malaise. There are seen numerous dirty greyish patches of membranous appearance, which adhere especially to the tonsils, due to a fibrinous exudation, the result of septic inflammation, leading, it may be, to suppuration of the tonsillar crypts. The lymphoid tissue in the pharynx and palate may be found similarly affected, especially in severe cases. The membranous patches soon disappear, leaving shallow ulcers in their place. The lymphatic glands in the neck are secondarily inflamed.

The *prognosis* is good. The condition must not be mistaken for diphtheria.

The *treatment* consists in removing the patient from the vitiated atmosphere, spraying the throat with a solution of corrosive sublimate (1 to 2,000), or of carbolic acid (1 to 100), gargling with a solution of chlorate of potash, sucking ice, and the administration of quinine and iron and of port wine, a stimulant which is invaluable where there is great debility.

Gangrenous ulceration may in rare cases, in very debilitated patients, result from an extension of the above malady. It has been sufficiently described under gangrene of the pharynx.

Syphilitic ulceration.—Syphilis of these parts is very frequently met with. Primary chancre of the tonsil has been already alluded to. Far more frequent, and therefore more important, are the secondary and tertiary manifestations, which are chiefly ulcerative.

The secondary ulcerations are mostly superficial, and are usually the result of syphilitic mucous patches breaking down. These slight ulcerations are most common on the tonsils, they are also frequent on the margins of the fauces. They have a greyish floor and well-marked edges, and remain superficial.

There is seldom more than soreness or slight pain, and the absence of acute suffering differentiates this condition from tuberculous ulceration.

The tertiary syphilitic ulcers are deep; they always result from the breaking down of gummata.

Gummata of the palate and tonsils are far less frequent than in the posterior wall of the pharynx, which is by no means an infrequent seat of such neoplasms. When a gumma has broken down, a deeply-excavated ulcer results, which is often roundish in shape, with distinct non-indurated edges, a dirty sloughy floor, and a surrounding zone of red, inflamed mucous membrane.

These ulcers usually heal rapidly under iodide of potassium; often, however, only after having caused a great loss of substance. When such heal, the cicatrization produces, therefore, much deformity. The soft palate may become adherent to the posterior pharyngeal wall, or, less frequently, to the tongue, or there may result much narrowing of the lower portion of the pharynx—the so-called stenosis of the pharynx. Most commonly, however, we find a puckered, radiating scar on the posterior wall of the pharynx.

Tuberculous ulceration is much less frequent than the syphilitic form. It usually, though not invariably, occurs in patients who present manifest signs of tuberculosis of other organs, especially lungs, larynx, tongue, and skin. It sometimes forms a most distressing late symptom in advanced tuberculous disease, and is then of the worst possible omen.

Primary tuberculous ulceration is excessively rare, the large majority of cases being secondary in origin. The ulcers are lenticular and shallow, and extend superficially, but not in depth;

coalescence of the ulcers early occurs. The ulcerated surface is greyish or dirty white in colour, with granulations protruding through in places. These ulcers are chiefly seen on the fauces; miliary tubercles may often be observed in the neighbourhood of the ulcers. The lymphatic glands are invariably affected and caseous; suppuration is seldom seen.

The great symptom is the intense pain. Another marked symptom is the difficulty in swallowing, often amounting to unendurable agony, so that the patient prefers starvation to the attempt to take food. There are the usual symptoms of advanced tuberculous disease—wasting, fever, especially increasing during the evening; sweating at night. Death almost invariably ensues, except in the excessively rare instances in which the condition is a primary manifestation of tuberculous disease.

Treatment.—Regarding the local treatment of this tuberculous ulceration, if the case be primary or slightly developed, the sharp spoon might be used, with subsequent application of lactic acid (25 to 75 per cent.). In the great majority of cases the treatment can only be palliative; spraying with cocaine, or the topical application of iodoform, with a small quantity of morphine, or a solution of menthol (25 per cent.) in oil may be employed.

The general treatment of tuberculous disease is also, of course, to be carried out.

Malignant ulceration results from the extension and subsequent breaking down of malignant tumours, either of a carcinomatous or a sarcomatous nature. The chief characters of this form of ulceration are the progressive increase in the size of the ulcers, their indurated, everted, irregular, and often nodulated margins, their fœtor and blood-stained discharge, the early involvement of the lymphatic glands, and the rapidly developed cancerous cachexia. It is important not to mistake tertiary syphilitic for cancerous ulceration. In cases of doubt, iodide of potassium soon settles the diagnosis, as under its action the syphilitic rapidly cicatrises, whilst the malignant ulceration steadily extends. A minute fragment may be excised under cocaine, and examined microscopically, or scrapings from the ulcer may be subjected to the same method of inquiry.

Tumours of the pharynx.—Tumours of the pharynx are uncommon. Of the **innocent tumours** papillomata are the only growths that are fairly frequently encountered. They may occur on any part of the mucous membrane, most frequently on the margins of the fauces and uvula, and on the posterior wall of the pharynx.

Fibromata, lipomata, nævi, cysts, and almost every variety of new growth may occasionally be seen in the pharynx, but all are very rare, the least so being the four named. The above give rise to trouble only by reason of their bulk. When small, they may pass unnoticed by the patient. Pedunculated tumours—such as papillomata—may be snipped off with scissors, or removed by the galvano-caustic snare. Non-pedunculated innocent growths are usually best treated by enucleation after incision of the mucous membrane covering them.

Malignant tumours of the pharynx, which are more common than innocent growths, are carcinomatous or sarcomatous in nature. The commonest malignant growth in the pharynx is the squamous epithelioma. In epithelioma the growth lies chiefly on the side walls of the pharynx, sometimes on the posterior wall. The condition may be primarily pharyngeal, or may extend from the tonsil or other neighbouring parts. In epithelioma pain on deglutition is a cause of very terrible suffering, so much so that the patient frequently either declines or is unable to swallow. There is usually a feeling as of a foreign body in the pharynx, and much secretion of foul-smelling, bloody mucoid discharge. The lymphatic glands in the neck are always secondarily involved, and form large masses, which attract the attention of the observer more forcibly than the frequently small primary growth.

In sarcoma, the rarer form of malignant disease of the pharynx, the pain is always much less severe than in epithelioma; sometimes, indeed, it is scarcely present to any appreciable degree. The symptoms of sarcoma of the pharynx are dependent chiefly on the bulk of the tumour. Dyspnoea rarely occurs, except in growths which may obstruct the orifice of the larynx—*i.e.* situated low down, or when they are of very large size. Difficulty in the performance of the act of deglutition, however, is almost a constant symptom in sarcoma, as pain in deglutition is in epithelioma. The glands in sarcoma are, as a rule, not affected. This is noteworthy, as in sarcoma of the tonsil they are commonly involved.

When ulceration has occurred in malignant disease of the pharynx, doubt may arise whether the condition be malignant or tertiary syphilitic. Iodide of potassium will usually render the diagnosis clear, but it must be borne in mind that not infrequently malignant ulceration seems for a time to improve under the use of iodide. On the other hand, certain cases of syphilitic ulceration may be very slow in healing under the use of the drug. In very doubtful cases, therefore, reliance must be placed on the microscopic examination of an excised fragment from the margin of the ulcer, which will give unhesitating proof of the nature of the disease. This is the more necessary, as in early cases of malignant ulceration the lymphatic glands may not be visibly involved. Sarcoma may be susceptible of a successful operative treatment, the disease being in rare cases thoroughly removable. Epithelioma is as a rule best left alone, as its eradication is almost always a futile endeavour.

Treatment.—In the great majority of cases of malignant disease of the pharynx operative treatment is not to be recommended. Should a sarcoma, however, be pedunculated or encapsuled, removal will hold out a fair prospect of success. The growth should be snared in the former, enucleated in the latter, condition. Epithelioma, with marked glandular involvement, is in all but the very earliest cases inoperable. In small defined epitheliomata which have not as yet affected the glands removal may be indicated, but such conditions are rarely encountered. Such tumours are, when situated on the

posterior wall of the pharynx, sometimes removed by sub-hyoid pharyngotomy—i.e. the opening of the pharynx for the removal of tumours or foreign bodies which cannot be dealt with by the mouth. In this operation the pharynx is explored by means of a transverse incision at the level of the lower border of the hyoid bone.

In the greater number of sarcomata, and in almost all epitheliomata, palliative treatment alone is indicated for the few months of

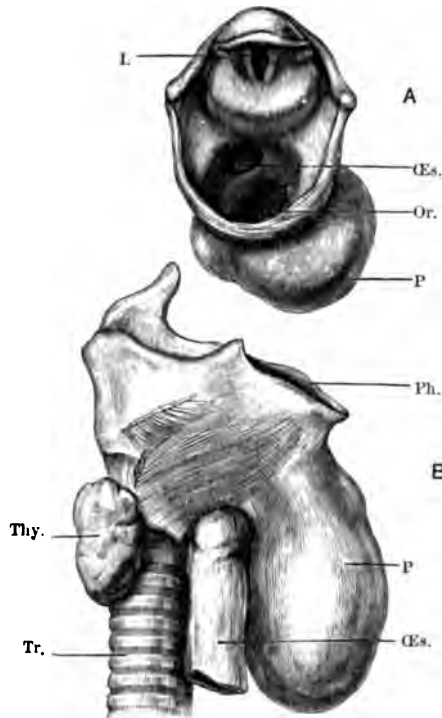


Fig. 758.—Pharyngocele or Bag-like Diverticulum from lower part of Pharynx. (From the Museum of St. George's Hospital.)

A, seen from above. P, Pouch; Or., orifice leading into pouch; Es., oesophagus; L, upper aperture of larynx. B, seen from the side. Ph., Lower portion of pharynx; P., pouch; Es., oesophagus; Tr., trachea; Thy., thyroid gland.

life which remain for the patient. Spraying with cocaine solution before administration of food, or painting with cocaine and menthol solutions, may be recommended. Morphia may be generously given to keep the sufferer out of pain as far as practicable. Rectal feeding is indicated when swallowing is impossible.

Pharyngocele.—Pharyngocele is the name applied to a rare but important condition, in which there exists almost invariably at the lowest part of the pharynx (just above its junction with the oesophagus) a peculiar bag-like diverticulum (Fig. 758). This pouch passes downwards behind the oesophagus and in front of the cervical

vertebræ, and almost always projects towards the left side of the neck. It communicates with the pharynx by means of an orifice which varies in size and is often slit-like.

The origin of this condition is still quite obscure. It is a debated point whether it be of congenital origin or an acquired deformity. In favour of its acquired origin is the fact that in all cases the earliest indications of the condition are observed for the first time in persons who have at least reached maturity, and usually are of middle age. Still, as Butlin clearly points out, the strong probability is that such pouches have their origin in defective development. They occur in the same situation on the posterior wall of the lowest part of the pharynx, which is amply supported by the vertebræ behind. They all have a tendency to pass towards the left side, and they are very rare, in spite of the gluttonous habits of many of the lower classes. Butlin further draws attention to their resemblance to Meckel's diverticulum of the intestine. The probability is that the pouch is congenital, but at first small in size; later it becomes dilated and elongated, until it may attain great dimensions, reaching in rare cases to the bifurcation of the trachea. The condition gives rise to no symptoms until it has reached a certain size. It is often referred to as a pressure pouch. The name is accurate only so far as the cause producing its increase in size is concerned. Objection may be taken to it as excluding the idea of the probable congenital origin of the diverticulum. In certain cases the sac is covered by muscular fibres derived from the inferior constrictor. More often, however, it appears to be a hernial protrusion of mucosa and submucosa through a gap in the muscular substance. The larger the sac the less the probability of its having a muscular coat, whilst the small diverticula are almost invariably surrounded by a muscular covering. This fact points strongly to the probability of the pouches originally possessing a musculature, which, by stretching, has become atrophied, until, in the course of years, no trace of it except a ring around the orifice leading into the sac remains. (See also page 540.)

The symptoms of a marked case are vomiting of undigested, often more or less decomposed, masses of food, and the characteristic bulging on the left side of the neck, which can be felt and often seen, and may be emptied by pressure, its contents escaping into the pharynx, whence they may travel downwards into the œsophagus, or may be returned into the mouth. There is interference with swallowing, which increases as the pouch grows larger, until death from inanition, due to semi-starvation, occurs. The condition is easily differentiated from stricture of the œsophagus by the passage of a bougie into the stomach. A fallacy lies in the possibility of the instrument entering the pouch, and being thus arrested in its downward course. When the pouch becomes large it can be seen to distend when a drink of water is taken. When full of food particles, symptoms may arise from pressure on the vessels, nerves, air- and food-passages. The condition is far more frequently seen in the male sex, more than 90 per cent. of recorded cases occurring in males.

Treatment.—All forms of treatment short of operation are useless. The wearing of a collar apparatus, so constructed as to keep up pressure on the pouch during meals, is inefficient and irksome. It will be far better to follow the example of Von Bergmann, Butlin, and Kocher, and perform the radical cure by excision of the diverticulum. To this end an incision may be made along the anterior border of the left sterno-mastoid from hyoid bone to sternum. The great vessels are drawn outwards and the larynx rotated, so that the posterior aspect of the pharynx presents in the wound. The pouch is then to be freed and cut off at its neck. The cut edges of the wound in the pharynx are then to be accurately sutured, and a large drainage-tube, reaching from the sutured wound in the pharynx to the skin incision, inserted to drain away any fluids which may leak from the wound, which, unless removed by drainage, would cause suppuration, which might spread to the mediastinum, and result fatally. This operation has in the few cases in which it has been performed been attended with the most satisfactory results, and the radical cure of a pharyngocele may be considered one of the most recent triumphs of surgery.

Stenosis of the pharynx. Causes.—Narrowing of the pharynx, the result of cicatricial contraction of ulcers, due to syphilis in the great majority of instances, less frequently to lupus, burns, scalds, and other injuries, and various forms of simple ulceration, is by no means uncommon.

The stenosis is more frequently due to abnormal adhesions of the soft palate. Much less frequent are strictures in the lower part of the pharynx.

Adhesion of the soft palate to the posterior wall of the pharynx is commonly only partial. Complete adhesion is very rare, there being almost invariably, even when the adhesion is bilateral, an aperture which will admit a catheter from the mouth into the nasopharynx.

The **symptoms** of partial adhesion of the palate are, in addition to obvious deformity, alteration in the voice, which sounds nasal, and difficulty in nasal respiration, with (rarely) some hindrance to deglutition. In complete adhesion the mouth, which is of necessity kept constantly open, as nasal respiration is impossible, is dry. Taste and smell are absent, speech is markedly indistinct. Deafness is common, as the result of the closure of the Eustachian tubes.

In other cases the soft palate is by dense cicatricial contractions drawn down towards the base of the tongue, the anterior pillar of the fauces and the epiglottis being in such instances often so much distorted as to be scarcely recognised. The stenosis in this situation is never absolute, though the opening is frequently exceedingly small, admitting only a small œsophageal bougie or large-sized catheter. In such a case it is obvious that the function of deglutition suffers severely, even with care. Only small morsels of food can be slowly swallowed.

The *diagnosis* of the above-described conditions is easily made by inspection. In the rarer cases, in which the stenosis is in the lower pharynx, the laryngoscope is needed for diagnostic purposes. In the

lower pharynx the cicatricial bands project into the lumen of the tube, and produce, as a rule, a tubal stricture of some length. The stenosis here may be so extreme that fluids only can be swallowed, but it is obvious that complete stenosis is an impossibility, as the patient could not live with total obstruction of this alimentary and respiratory passage.

In extreme stenosis the patient can only take fluid nourishment. There is hindrance to respiration, dyspnoea on active movement and during the slow swallowing of food, and there is the ever present danger of death from suffocation, due to the impaction of too large a portion of food being attempted to be swallowed.

Treatment.—In partial adhesion of the soft palate to the posterior wall of the pharynx the wisest treatment is to leave the condition alone, as the symptoms are practically nil. In total adhesion the soft palate must be detached from the posterior pharyngeal wall, and the re-adhesion prevented by the passage of bougies, or, better, by the introduction through the newly-made aperture of an indiarubber ball, which is inserted collapsed, and then blown up *in situ*. This method I have recently employed with considerable success in the case of a patient with total palatal adhesion and deafness, due to obstruction of the Eustachian tubes.

In cases where the soft palate is drawn downwards towards the root of the tongue as a rule the inconvenience suffered is but slight, and no treatment is called for. If, however, there be a troublesome interference with deglutition, owing to the constriction between the buccal cavity and pharynx being very marked, the stricture may be divided in two or three places by a probe-pointed knife cutting upwards, and dilatation maintained by the constant passage of bougies.

Stenosis of the lower pharynx, when marked, calls for operative treatment, as there is danger to life from the tendency to impaction of food in the stenosed region, causing asphyxia. With the help of a laryngeal mirror the stricture may be incised in a backward direction by means of a probe-pointed knife, or cicatricial bands may be divided or excised by scissors. The constant passage of bougies, or the introduction of Schrotter's dilating tubes must then be employed. There is, however, a strong tendency to recontraction of the stricture. In such operative procedures a preliminary tracheotomy is often advisable, for though the topical application of cocaine abolishes much of the reflex paroxysmal coughing and dyspnoea, there is always a risk of blood finding its way into the trachea.

XLVI. AFFECTIONS OF THE ŒSOPHAGUS.

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AFFECTIONS of the œsophagus may be considered under the following heads :—

Malformations,
Pouches,
Foreign bodies,
Ruptures,

Wounds and injuries,
Idiopathic œsophagitis,
Tumours and stricture.

Difficulty in swallowing is rarely, if ever, absent in any of these affections, and in most of them forms a prominent feature.

The œsophagus being deeply situated, its affections are rarely obvious without a careful examination both of its interior and of the structures which surround it. In these circumstances it may not be amiss to preface our remarks by a description of those methods of examination which are most appropriate for the detection either of injury or disease.

Examination of the œsophagus.—The œsophagus is about 9 inches in length, and extends behind from the fifth cervical vertebra to the ninth dorsal, and in front from the cricoid cartilage to about the level of the ensiform cartilage. Its direction is almost absolutely vertical. In the neck it is in relation with the trachea in front and the vertebral column behind. On either side of it are the two carotids and recurrent laryngeal nerves. In the thorax it abuts in front on the trachea, left bronchus, the arch of the aorta, pericardium and left vagus. Behind it rests mainly on the vertebral column and thoracic duct, but crosses over the aorta about 3 inches above the diaphragm, and on either side are the two pleuræ.

Difficulty of swallowing, as has already been stated, is rarely absent in œsophageal affections, but it may result from pressure on the œsophagus from the outside as well as from intra-œsophageal obstruction. Those conditions which give rise to obstruction by external pressure are, as a rule, quite obvious; difficulty in diagnosis is rarely encountered. The commoner causes are aneurysm of the aorta and abscess of the vertebral column due to Pott's disease. Among the rarer affections are tumours growing in close proximity to the

œsophagus, gummata, enlarged lymphatic glands, and occasionally thyroid enlargements. Enlarged lymphatic glands and gummata can rarely be detected with certainty during life. Their presence can only be inferred from the existence of similar conditions elsewhere in the body. They are liable to be confounded with stricture.

An attempt should be made to exclude the possibility of all such causes before embarking on the passage of a bougie. Especially is this necessary in the case of an aortic aneurysm. More than one instance is on record where the aneurysm has been ruptured by a bougie even when it has been passed by an experienced hand.

A condition which is indistinguishable from œsophageal obstruction may be simulated either by muscular spasm or by paralysis. Muscular spasm is an affection chiefly met with in young women, is of a so-called hysterical nature, and is often associated with other hysterical conditions. Practically the only likely cause of paralysis is diphtheria, and though it may occur at any age, it is far more common in childhood. The history of the onset of such conditions, and the ready passage of a full-sized bougie will soon dispel any uncertainty in such cases, if it ever exists.

Assuming that some obstruction exists, as is evidenced by the difficulty of swallowing, which has been gradually coming on for some weeks, or that palpation of the neck has afforded no indication of its seat, and that no evidence of any cause external to the œsophagus can be detected, *the passage of a bougie* should be undertaken. A medium-sized instrument should be selected from 20 to 24 in. in length, about the size of a No. 12 English catheter, or a little larger. It should be sufficiently flexible to accommodate itself to the curves of the œsophagus, and at the same time firm enough to overcome any moderate amount of obstruction. Those which are known as elastic silk web bougies are the best for the purpose. The same material is often made use of in the construction of œsophageal feeding catheters; but for this purpose the ordinary red rubber is preferable, from its greater softness and durability. The old-fashioned hard, red bougie, similar in construction to the English make of catheter, is far too hard, and much more liable to cause injury to the parts, especially in inexperienced hands.

After the bougie has been thoroughly warmed in hot water, or by holding it for a few seconds in front of the fire, it should be well lubricated with glycerine, which will be found to be more agreeable to the patient than anything of an oily nature. The patient should be seated in a straight-backed chair, his head resting on the back, or firmly grasped by the hands of an assistant. The surgeon, standing on the patient's right, takes the bougie in his right hand, and with his left forefinger guides it gently over the dorsum of the tongue, so as to prevent it from straying into the nasal passages or larynx. There is usually a momentary spasm, and sometimes a tendency to vomit when the point of the bougie impinges on the back of the pharynx, but with gentle pressure this is, in most cases, readily overcome, and the bougie passes onwards without difficulty, until the real obstruction

(if there be one) is encountered. If the bougie which was first selected does not afford sufficient evidence of the actual conditions of affairs, larger or smaller ones must be subsequently employed, as the case may demand. It is useful to remember that the distance from the teeth to the cardiac orifice of the stomach in an average-sized adult is about 16 in., and that the œsophagus itself is about 9 in. in length. It must, however, be borne in mind that a soft bougie may be bent sideways, both in the mouth and pharynx, and thus considerably increase the apparent distance which has to be traversed.

Auscultation of the œsophagus, which was at one time much lauded as a method of diagnosis, has not yielded the results which were expected of it. Indeed, it may be doubted whether it ever yields as much evidence as the passage of a bougie. As first proposed by Hamburger, it consists in causing the patient to swallow some water or thickened fluid, such as gruel, and then listening either with the stethoscope, or directly with the ear over the course of the œsophagus behind. It is not difficult to detect the stoppage or slowing of the food current at the seat of stricture, but no evidence of the nature of the stricture or other diseased condition is afforded by this procedure.

Nor is much more information to be gained from the œsophagoscope, and the surgeon is compelled, therefore, to rely on his educated sense of touch and his bougie, coupled with such general indications as the special features of the case may supply him with.

Malformations and pouches.—Malformations of the œsophagus are rarely met with. *Occlusion or stricture* just at the junction of the pharynx with the œsophagus is the result of an incomplete union of those structures during the early months of growth and development. It is a condition incompatible with life, at any rate for more than a few days.

It seems probable that some *diverticula* may originate in a somewhat similar developmental defect. More commonly, however, they are the result of some attack of inflammation, by which the muscular coats have been weakened, and the mucous membrane gradually bulging through the opening in the muscular fibres, the sac grows larger and larger as portions of food find their way into it. In their earlier stages such pouches are rarely noticed. Later, their enlargement gives rise to violent fits of coughing, caused by pressure on the larynx or its nerves. An examination of the neck in such cases will reveal the presence of a swelling, which varies in size from time to time, and from which food can be squeezed by external pressure, and made to regurgitate, accompanied often by air, into the mouth. The tendency of such sacs is to increase in size, and to give rise to more distressing symptoms as age advances. An operation for their removal should be undertaken from the outside. It has been successfully accomplished in several instances. (See also page 540.)

Foreign bodies in the œsophagus.—The presence of a foreign

body in the œsophagus is always serious, and often demands promptitude for its removal. The most common cause of accidents of this nature is the accidental lodgment of a piece of bone, gristle, or other substance which has been introduced with the food. Of rarer occurrence are fish fins, false teeth, forks, and fruit stones. Persons of unsound mind often require to be carefully watched in order to prevent them from swallowing anything that may be at hand, and a fork readily finds its way into their gullet. In children, with their well-known propensity of putting articles of all sorts into their mouths, it is not surprising if foreign bodies are occasionally

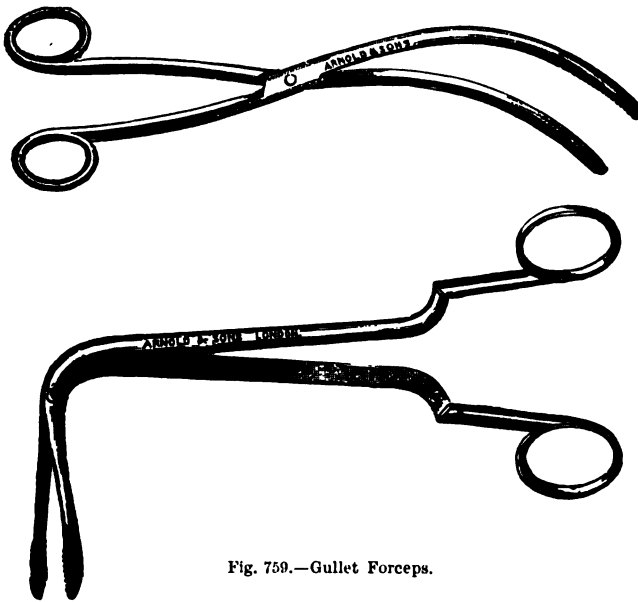


Fig. 759.—Gullet Forceps.

swallowed. In one or two instances, impelled by youthful love of mischief or of sport, they have been known to angle with a baited fish-hook in the mouths of their friends, and sometimes with disastrous consequences.

Diagnosis and treatment.—Occasionally the impaction of a foreign body gives rise to an attack of vomiting, which results in the expulsion of the offender, and formerly it was customary to endeavour to induce vomiting in these cases by the administration of an emetic. Such a plan was rarely if ever successful, and has given way to more rational modes of treatment. It must be borne in mind that impaction usually takes place in one of three situations, either at the upper or lower extremity of the œsophagus, or just where the bronchus crosses it.

The diagnosis does not usually present much difficulty. The

history of the passage of something is rarely absent if the patient is of sound mind, or old enough to express his feelings. Added to this are symptoms of discomfort, and especially if the body is situated high up there is oftentimes a distressing cough, accompanied by the expectoration of mucus and possibly of blood. The passage of a



Fig. 760.—Grapnel Probang.

bougie, unless the foreign body be very small, will remove all possible doubt.

An attempt should be made without delay to remove it if possible through the mouth. If it is situated just below the pharynx, it will be able to be seized either by forceps (Fig. 759) or with the aid of a grapnel probang (Fig. 760), and with the help of the fingers of the other hand on the outside of the neck will in all probability be capable of removal. Should this plan fail after several attempts have been made, œsophagotomy must be resorted to without delay, or dangerous inflammation of the œsophagus and its surroundings is almost sure to occur. The operation is usually performed on the left side of the neck. When the foreign body is situated lower down it can rarely be pulled upwards, but will possibly yield to the gentle pressure of a probang (Fig. 761) and find its way into the stomach. Should it, however, prove to be firmly impacted in the thoracic portion of the œsophagus it might be reached in the post

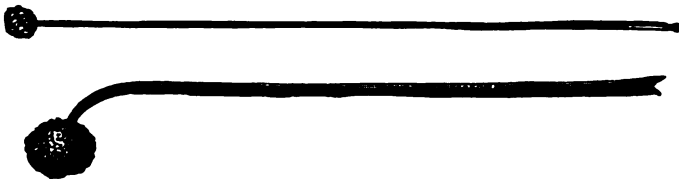


Fig. 761.—Probangs tipped with Sponge.

mediastinum by cutting through one or more ribs.* If left to themselves such cases usually terminate fatally (Fig. 762) from deep suppuration, blood-poisoning, pericarditis, pleurisy, or hæmorrhage from some large vessel.

Should the foreign body be fixed so low down as to be within reach of the cardiac orifice of the stomach, and show no inclination to move onwards, it must be reached and removed through an opening in the stomach.

* This plan of treatment, though suggested by Nasiloff (St. Petersburg *Vratch*, 1888, No. 25), has not, so far as I am aware, been carried out in the case of a foreign body. It need not present any great difficulty, and has indeed been employed by Mr. W. G. Spencer (Clin. Soc. Trans., vol. xxvi. p. 226) with complete success for the drainage of a mediastinal abscess.

When the foreign body is of so small a size as to elude detection by any of the methods above enumerated, the horse-hair probang (Fig. 763) may often be used with success. It must, however, be introduced with care, for pins, fish-bones, and the like may be easily pushed onwards and the pericardium or pleura wounded.

So long as the foreign body remains *in situ*, or any doubt remains of its removal, mealy farinaceous food, such as gruel, etc., should be administered in order to facilitate its passage through the bowels. Purgatives should be rigorously avoided. It is well to bear in mind that when once it has been made to enter the stomach it will probably, with judicious management, traverse the intestinal tract, though it may lodge just above the external sphincter, and demand a little digital assistance.

Rupture of the œsophagus.—Rupture of the œsophagus is a condition scarcely met with and hardly ever capable of detection during life. It is invariably fatal. From a perusal of the description of those cases where this accident has occurred, it would appear that it generally follows an attack of vomiting after a full meal, or a drunken bout. The patient usually experiences a sensation as if something had given way, and at once is attacked with excruciating pain, which is followed, if he does not at once succumb, by emphysema of the tissues round about the œsophagus, and is first observable at the root of the neck. If vomiting has occurred before the onset of the attack it usually ceases. As a rule there is no difficulty in swallowing. The pain gradually increases, and is aggravated by the least movement.

In every recorded case but one the rent in the œsophagus has been longitudinal in direction, and from 1 to 2 inches in length.



Fig. 762.—Ulceration to which unremoved Foreign Bodies ultimately give rise. The foreign body in question is a coin of the United States. (After Agnew.)

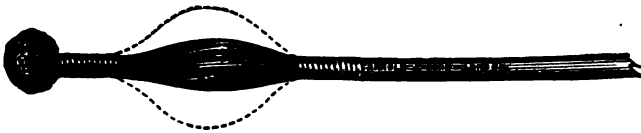


Fig. 763.—Horsehair Probang.

Food and fluid have usually found their way into the mediastinum and from it into one or both pleural cavities. How far this accident is attributable to degenerated tissues it is impossible to say, but in most of the cases it would appear that degeneration was present in other parts of the body.

Wounds and injuries.—Wounds are usually the results of

cut-throat, stabs, bayonet thrusts, or bullet wounds. They are occasionally produced from the inside by "sword swallowers."

The walls of the œsophagus should, if possible, be carefully adjusted and sutures inserted. Fistulous tracts sometimes persist for a time, but eventually close.

Severe injuries often result from *the swallowing of corrosive fluids*, either by accident or with suicidal intent. In many cases it is well to remember that so rapid has been the act of swallowing that the lips and fauces are scarcely touched by the corrosive fluid. The symptoms depend largely on the amount and character of the fluid which has been swallowed. Intense burning pain, followed by rapid collapse, is usually present, and is often accompanied by the presence of black vomit containing blood, mucus, and shreds of injured mucous membrane. If the patient survive the injury, the symptoms of collapse will probably abate, the pain and swelling diminish, and fever pass off.

Treatment should be directed towards diminishing pain. Opiates should be administered, and the patient fed per rectum. As soon, however, as the painful symptoms pass off, feeding may be gradually resumed by mouth, milk and other simple fluids being taken in small quantities. A bougie should be introduced as soon as it can safely be undertaken, with a view to preventing or minimising the cicatricial contraction which is sure to follow, and which, if the patient survive, may necessitate gastrostomy later in order to avoid starvation.

Idiopathic œsophagitis.—In addition to the acute inflammation of the œsophagus which supervenes upon the injury inflicted by the swallowing of caustic fluids, there is a form of this disease which is idiopathic in nature. Of rare occurrence, it appears to originate in the pharynx, and spread downwards, though it may spread upwards after an attack of gastritis. The most marked symptom is extreme pain on swallowing; so much so, that even a few drops of milk or water seem to give rise to intense agony. If no swallowing is taking place, the patient only experiences a dull aching sensation; but the mere act of talking is sufficient to bring on an attack of pain. Glairy mucus is often expectorated. More rarely still it is attended by suppuration.

Complete rest and rectal feeding are the only indications for treatment, with the administration of morphia to allay pain. Under this mode of treatment the pain usually abates after a few days, though complete recovery requires a week or two. In the last stage of some exhausting diseases an aphthous condition of the pharynx and œsophagus occurs, accompanied by much the same symptoms.

Of the causation and pathology of acute œsophagitis nothing for certain is known. A chronic form of œsophagitis accompanies syphilitic and tuberculous conditions of the œsophagus when they occur.

Tumours and stricture of the œsophagus.—**Innocent**

tumours have been known to grow from the wall of the œsophagus, but more commonly they only hang down into it, their seat of origin being in the pharynx. If this should be the case, they are either within reach of the finger or can be rendered visible by the aid of reflected light. They may all be comprised under the following heads: mucous cysts, dermoids, fibroma, adenoma, and myoma. They can generally be reached and removed by ligature or the galvano-cautery. In rare instances œsophagotomy may be needed. If they are situated lower down their presence can only be inferred from the difficulty in swallowing to which they give rise: it can never be determined with certainty during life, unless they happen to be extracted by chance with a probang.

Of **malignant tumours** squamous epithelioma alone claims our attention. It is commoner in men than in women, and is chiefly met with as age advances. It manifests itself as an annular constriction, situated usually at the upper or lower extremity of the tube, though it may occur in any portion of it. By far the great majority of cases of true stricture which occur after forty-five years of age are of malignant nature. From a perusal of the statistics of the cases of stricture that have occurred in St. Bartholomew's Hospital during the last ten years, it appears that less than 5 per cent. of the malignant cases occurred before the age of forty-five years. The process of ulceration is so rapidly succeeded by that of contraction, that stricture speedily supervenes, and death results as in other œsophageal affections, either from implication of the surrounding structures or from blood poisoning.

Perforation of the trachea (Figs. 764, 765, 766) is soon detected by the passage of food into the air-passages, and of air into the œsophagus. Severe attacks of coughing accompany

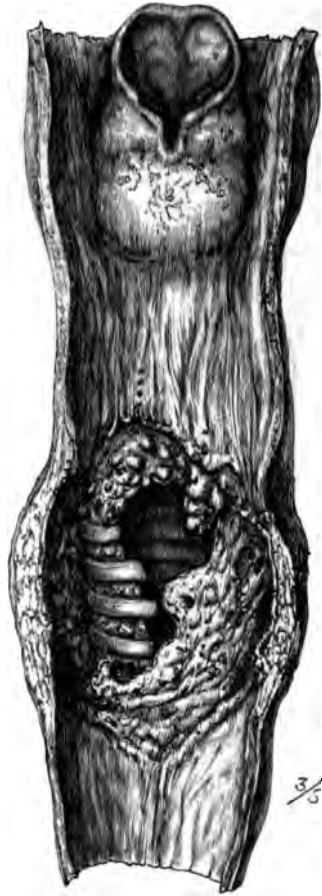


Fig. 764.—Cancer of the Œsophagus, ulcerating into trachea, destroying and laying bare several of the rings. (From specimen in the Museum, Temperance Hospital.)

this condition, and when once it is well established, life is rarely prolonged for more than a few days, septic pneumonia speedily supervening.

The perforation of the pleura or pericardium is of less common occurrence, but is more rapidly attended by a fatal issue.

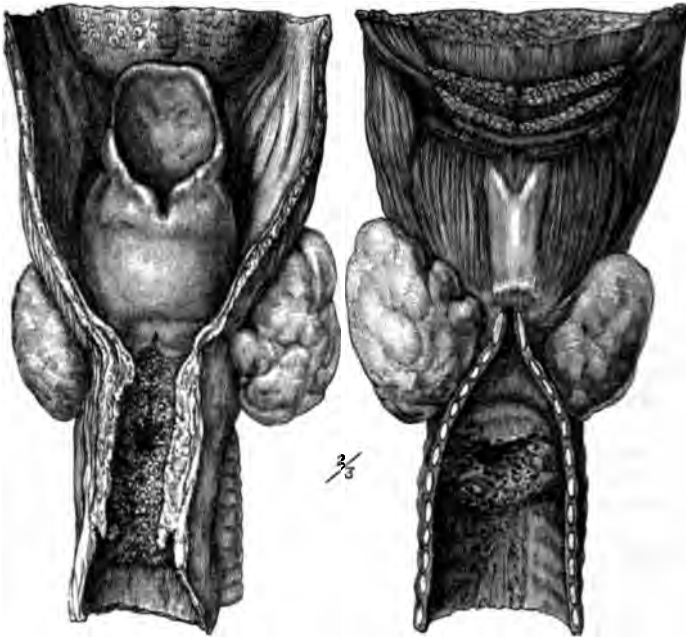


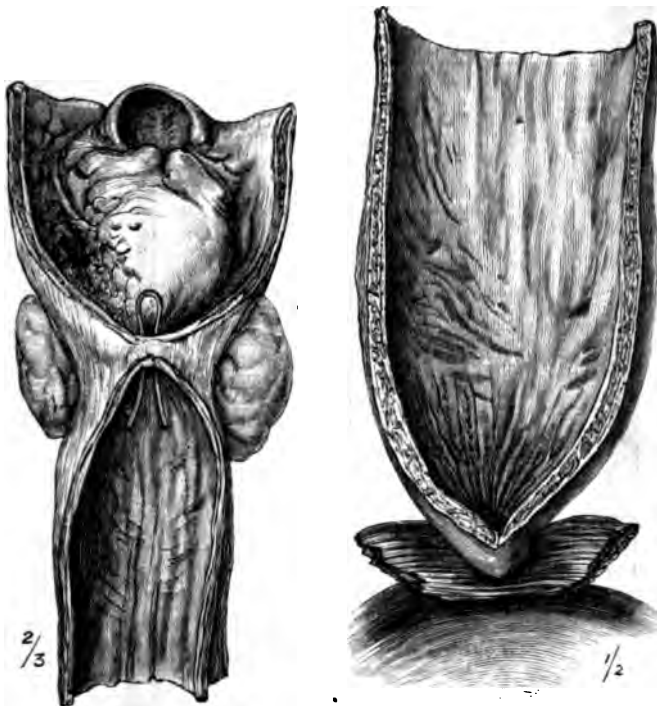
Fig. 765.—Cancer of the Œsophagus perforating the Trachea: viewed from the œsophagus. (From specimen in the Museum, St. Bartholomew's Hospital.)

Fig. 766.—Cancer of the Œsophagus perforating the Trachea: viewed from the trachea. (From specimen in the Museum, St. Bartholomew's Hospital.)

Until the later stages of the disease no other symptom is present than that of increased difficulty of swallowing, though occasionally vomiting occurs, owing to particles of food, mucus, and saliva which have collected on the surface of the stricture. This is especially the case with those strictures which are situated high up, inasmuch as pouching (Figs. 767, 768) above the stricture is more likely to occur, thus affording a ready lodgment for food, etc. When the tumour is situated in the upper part of the œsophagus, cough and loss of voice early supervene, owing to the implication of the larynx and its nerves.

Treatment can seldom, if ever, be anything else but palliative; but gastrostomy, if it has not yielded the results which were at one time hoped for from its performance, tends greatly to diminish the sufferings of the patient. That its immediate mortality has been

high has been due to the fact that too often it has not been performed till the patient was too ill to undergo it. These results are already improving, and still further improvement may be looked for. To some extent the short time which a patient usually survives the operation is attributable to the same cause. The operation has been compared by some authors to colotomy, with the implied assumption that the prolongation of life ought to be about the same in both affections; but this can never be the case. The situation of the œsophagus must be taken into consideration, and its closer proximity to vital structures recalled if one is to gauge accurately the advantages of an operation in any given case. The aorta, the thoracic duct, the lungs, and the heart are all in its immediate vicinity; any one of them may be invaded by the progress of the disease, and with a certainty of a rapidly fatal issue.



Figs. 767 and 768.—Pouching of Œsophagus above Cicatricial Stricture. (St. Bartholomew's Hospital Museum.)

In many instances better results will be obtained by the wearing of a Symonds tube (Fig. 769) than are likely to ensue from gastrotomy. If the proper guide (Fig. 770) be not at hand, it can be introduced with an ordinary small œsophagus bougie. Great care

must be used in its introduction, and the silk thread which attached to it brought out at the corner of the mouth and firmly

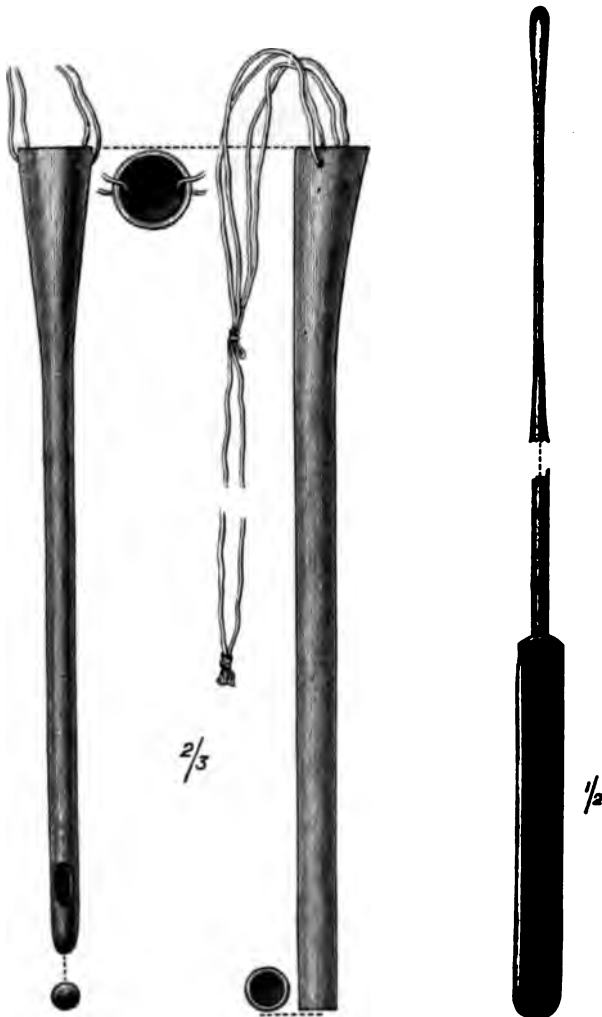


Fig. 769.—Symonds' Œsophageal Tube. Fig. 770.—Guide for Symonds' Œsophageal Tube.

secured either to the ear or affixed by a piece of strapping to the skin in its neighbourhood. Occasionally one of these tubes can be retained for a month or two without being changed; but so long a period of retention is rarely advisable, and often gives rise to

considerable local irritation, thus necessitating its removal. The thread should be examined daily, lest it become cut by the teeth ; in which case the removal of the tube may prove no easy task to effect, and may necessitate operative interference.

A **non-malignant stricture** (Figs. 767, 768) is less often met with ; but when it does occur, it almost always arises from the swallowing of hot or corrosive fluids, strong acids, alkalies, etc. In extremely rare instances it results from syphilis or tubercle, or may even, it is said, be congenital. Some history of an exciting cause is generally present. So far as the early symptoms go, it is indistinguishable from one of malignant nature. It is rarely possible at this stage of the disease to determine its cause with accuracy if no history of injury is forthcoming. It is only as the disease advances, and one possibility after another is excluded, that the true diagnosis is arrived at.

XLVII. INJURIES AND DISEASES OF THE ABDOMEN.

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INJURIES OF THE ABDOMEN.

General considerations.—The gravity of injuries to the abdomen depends mainly—it may almost be said entirely—upon the possibility of the lesion involving the peritoneal cavity or the contained viscera. The peritoneum is an exceedingly delicate and sensitive membrane, and although it possesses remarkable powers of repair, it is still very susceptible to inflammatory changes which tend to become rapidly diffused, and to lead to a fatal septic poisoning.

The organs within the abdomen are all of primary importance to life, and are all—so far as the resistance of direct violence is concerned—comparatively frail. The liver and spleen are very brittle and very vascular. The intestine contains micro-organisms which have the power of inducing inflammation, and is occupied by a substance which is capable of damaging the peritoneum, and of rendering inert its power of resisting a bacterial attack.

Shock and hæmorrhage are the two common causes of death immediately after the injury, and later come the dangers of peritonitis and septic intoxication, and the exhaustion which may attend the formation of fistulæ or the persistence of an abscess.

The viscera are protected in many ways. The same spinal nerves supply both the integument of the abdomen and the muscles of its anterior wall, and thereby a means is afforded of executing the most speedy reflex act. The muscular wall of the abdomen, by its elasticity, by the power with which it can contract, and by the firm cuirass the contracted fibres present, forms an admirable protection. Sudden flexing of the spine in the lumbar region narrows at once the exposed area of the abdomen and withdraws the parietes, as it were, from an impending blow. Certain of the viscera, notably the intestine, are protected by their great mobility and elasticity and by the covering afforded by the omentum.

The solid organs, the liver, the spleen, and the kidney, derive protection from the adjacent bones, and, in the case of the last-named

viscus, from the depth of its position. Of all the organs the pancreas, by being deeply placed in front of the upper lumbar spine, is the most admirably protected from injury.

It only remains to be noted that while the peritoneum is so susceptible to injury when attacked upon its internal or endothelial surface, it will permit of not inconsiderable violence and of rough handling when approached from its external attachments. This is well illustrated by the old operations for ligaturing the iliac arteries by an extra-peritoneal dissection.

Classification.—Injuries of the abdomen may be classified as follows :—

1. Injuries without visceral complications—

(a) Contusions.

(b) Wounds.

2. Injuries with visceral complications—

(a) With rupture of viscera.

(b) With wound of viscera.

1. **Injuries without visceral complications :** (a) **Contusions.**—Contusions due to falls, kicks, and blows follow the course of like injuries elsewhere. On the abdomen they are often attended by considerable extravasations of blood, which may extend in the lax subcutaneous tissue, or in the spaces between the great muscles of the abdominal wall, and which may lead to trouble if they be not speedily absorbed.

Rupture of muscle, and especially of the rectus muscle, is not very uncommon in this class of injury. The rupture is probably due to a sudden and violent contraction of the muscle to meet the impending blow, and is not the result of direct violence. A blow sufficiently severe to tear across the rectus muscle is almost certain to cause some injury to the viscera. As a remote consequence of such rupture of muscle-fibres a ventral hernia may appear some weeks or months after the accident.

One circumstance is especially to be noted in connection with contusions of the abdomen, and that is the common occurrence of shock. This may be alarming and profound, and yet in a few days the patient may be convalescent. On the other hand, it may be not very marked, and yet before a week has passed the patient has died from the effects of some rupture of a viscus. There is, indeed, no invariable and regular relation between the severity of the damage done and the degree of shock. In some cases—as in railway and street accidents—the element of terror and alarm may be concerned in the production of shock, but certain is it that even in patients who make a speedy recovery it may be quite profound. It is probable that in these cases in which shock is marked there is some slight visceral injury which is sufficient violently to impress the great system of the abdominal nerves, but which is soon recovered from and leaves no trace. In a quite large proportion of cases of contusion of the belly vomiting occurs, and may be a marked feature.

In any case of contusion of the abdomen a guarded prognosis should be given. The patient should be kept at absolute rest in bed in the recumbent position. The abdominal muscles should be relaxed by flexing the hip joints, a pillow being placed beneath the knees. Provided there be no subcutaneous bleeding, pain may be relieved by warm fomentations to the abdomen. Opium may be given with the same object. The diet should be of the sparest and simplest. Shock is met by hot bottles to the extremities, and by the cautious use of stimulants. Careful search should be made from time to time for evidences of intra-peritoneal extravasation, as shown by areas of dullness, etc. (page 561). Later, subcutaneous effusions of blood may be dispersed by massage, and it may be necessary to support the abdominal wall by a bandage or binder.

If the circumstances of those numerous cases of "contusion of the abdomen," which are constantly being admitted into the wards of large hospitals, be considered, they would be found to yield some such result as the following. The greater proportion, when admitted, are suffering from shock, and many from alarming shock. In many of the cases there is vomiting and great abdominal pain. A certain number are admitted for precautionary reasons, especially those patients who are under the influence of drink. About 75 per cent. of the cases of "contusion of the abdomen" make a fair and speedy recovery. Some 10 per cent. recover after developing obscure evidences of internal injury, and manifest evidences of peritonitis or peritoneal effusion. The remaining 15 per cent. are found to have a more or less evident rupture of a viscus.

(b) **Wounds.**—All forms of wound may be met with in the parietes of the abdomen. They receive no special features from their position, and call for no very special measures of treatment. It is desirable, if the wound be in any degree extensive, that the patient be kept in the recumbent posture during the healing process. This is especially desirable if the abdomen be pendulous. The fact that it is difficult to fix the abdominal wall, and keep it at rest, may explain the circumstance that some wounds in this region heal tardily. If the wound be incised, and if the several muscular layers of the abdomen be divided, it is desirable that the divided muscular strata should be united by fine silk sutures which are left buried; the skin wound may be united by silkworm-gut sutures.

In the case of punctured wounds with some contusion of tissue (as when some not quite sharp-pointed body has caused the lesion) it is well not at once to close the wound, but to bury the part in iodoform and await events. If the wound be closed a considerable subcutaneous or intermuscular effusion, either of blood or of inflammatory material, may follow. In the case of lacerated wounds of the abdominal wall it is desirable that the injured part should be well opened up, and all dirt, foreign bodies, blood-clot, and crushed tissue removed. In many instances the wound may then be united as an ordinary incised wound, and the skin brought together. A drainage-tube in such a case might be left in for thirty-six hours. In other

examples of lacerated wound it may be wiser to leave the wound in whole or in part open in order to allow of the escape of the products of inflammation and destruction of tissue.

If suppuration occur, it may readily spread far and wide between the layers of muscle or under the skin, and give rise to great trouble. In any instance, if the wound be deep, and the muscle tissue be extensively divided, a ventral hernia may follow at a longer or shorter interval after the wound has healed. Other things being equal, this complication is more common when suppuration has taken place. In all extensive wounds of the abdomen the patient should be kept in bed until the healing is perfectly sound, and should then wear a bandage or binder for some months after he is about again.

2. Injuries with visceral complications: (*a*) **With rupture of viscera.** *Circumstances in the ætiology.*—Rupture of an abdominal viscus may follow upon a severe blow to the abdomen, especially a very sudden and well-localised blow, such as that from the kick of a horse; or may occur in connection with falls, or even as a result of violent muscular contraction in instances in which viscera are diseased.

Rupture of a viscus has followed a comparatively slight injury; and, on the other hand, a patient has escaped internal damage after what may be regarded as a most violent blow.

The circumstances which determine laceration of an abdominal viscus in injuries apparently of equal degree are numerous. In the first place, much depends upon the attitude of the body. If the body be bent forwards at the time that the blow falls, an internal injury is much less likely to result than if the body be quite erect at the moment of injury. In the second place, much depends upon the preparedness of the patient, and the strength of his abdominal muscles. The greater injury would occur when a blow fell quite unexpectedly upon the abdomen of an individual of feeble muscular development. In some of such cases it is surprising what slight violence has led to a fatal laceration of an abdominal organ. The lesser injury would be in the subject who could so far anticipate the blow as to contract a vigorous abdominal wall. In such an instance muscle fibres may be torn, but the viscera may escape. In the third place, much depends upon the condition of the viscus, whether it be full or empty, as in the case of the stomach and bladder; and whether it be sound or diseased, as in the case of the liver or spleen. The enlarged spleen met with in the subjects of chronic malaria has been ruptured by quite trifling violence. I have seen a case in a young woman, in which fatal rupture of a hydatid cyst of the liver followed upon the sudden clasping of the patient round the waist by her husband.

In instances in which the patient has fallen from a height, or has been injured when wrestling or struggling, or when under the influence of drink, the manner in which a rupture of a viscus has been brought about is often difficult to determine.

The same observation applies to many railway injuries.

The organs ruptured.—In some instances, as in buffer or railway accidents, there may be an almost total crush of the chief viscera, but these cases do not come into the category of practical surgery.

The following are the viscera usually ruptured in order of frequency: liver, spleen, kidney, stomach, and intestines. Out of seventeen recorded cases of fatal rupture of viscera, the liver was concerned in nine instances. Among rarer injuries may be mentioned—tearing of the gall bladder, rupture of the spermatic cord, or of the ureter, and laceration of the mesentery. Rupture of the peritoneum alone is rare, but undoubted examples of this injury have been recorded.

There appears to be no recorded instance of rupture of the pancreas.

The following examples of tearing of blood-vessels, without external wound, have been recorded: the vena cava (in several instances), the aorta, the portal vein or some of its tributaries, the pancreatico-duodenal artery, the inferior mesenteric artery. The veins are much more frequently torn than the arteries.

In the illustrations just given the hæmorrhage has been fatal, but in many cases in which smaller vessels have given way there has been an extensive *subperitoneal extravasation of blood*, which, after a variable period, has cleared up. Collections of blood have been met with in the lesser sac of the peritoneum, as a result of violence. In these instances of subperitoneal or intra-peritoneal hæmorrhage, the symptoms are usually those which attend a severe abdominal injury—namely, shock, anæmia, abdominal pain, and vomiting.

Causes of death.—These injuries are all exceedingly fatal. In a certain proportion of the cases death results at once from shock. In the most marked instances of sudden death from these injuries, it is often found that the blow has fallen more or less directly over the region of the solar plexus, or that a very extensive area of peritoneum has been involved, or that the patient is the subject of cardiac disease. If the patient survive the immediate shock, the two most usual causes of death are hæmorrhage and peritonitis. Bleeding is the common cause of death in rupture of the liver or spleen, or of the great vessels. Peritonitis is associated with rupture of the stomach or intestines. Ruptures of the gall bladder are peculiarly fatal. Injuries to the kidney may prove fatal from hæmorrhage, or, at a later period, from destructive changes in the organ itself.

Injuries to the pancreas may lead to the formation of cysts, which may prove a cause of death.

In cases of hæmorrhage, death may follow directly from the sudden and copious outpouring of blood. In examples, however, of fatal rupture of the liver or spleen, the amount of blood found in the peritoneal cavity is often very much less than might have been expected.

If the patient survive, a considerable quantity of extravasated blood may be absorbed. The effused blood may undergo decomposition, and this without of necessity a perforation of any of the

hollow viscera. Blood, normal bile, and normal urine are not of themselves capable of exciting peritonitis. They are to be regarded as sterile fluids. They appear very capable, however, of damaging the fine surface of the peritoneum, of impairing its germ-resisting power, and of effecting such changes as will allow of micro-organisms passing into the serous cavity from the bowel. They provide, moreover, an excellent medium for bacteria to flourish in. The escape of the contents of the stomach or intestine is usually followed by speedy peritonitis. The irritating contents of these viscera damage the peritoneum by mere contact, and render its remarkable power of dealing with noxious bacilli inert. Moreover, there are micro-organisms in the stomach and bowel which are capable of inducing, under favourable conditions, an inflammatory process.

Peritonitis setting in after rupture of a viscus is not of necessity fatal. It may lead to adhesions, and to the localisation of the mischief.

The general symptoms.—These vary greatly. The principal and most common phenomena are those which attend any abrupt and severe lesion of the peritoneum, and which have been collectively spoken of as "peritonism" (page 605). The symptoms are these—(a) There is marked shock to the extent, in some cases, of insensibility. The pulse is quick, soft, and fluttering, and so small as scarcely to be felt; the skin is blanched, a cold sweat covers the forehead, the respirations are shallow and sighing. The expression is one of profound anxiety and distress. There is usually much restlessness and moaning; (b) pain in the abdomen, which is intense as a rule, and often spoken of as burning. Now and then it is evident that the pain is terribly severe. It is continuous, and not like the pain of colic; (c) vomiting. This symptom is seldom absent, and is usually noted at an early period. The vomited matter consists of the contents of the stomach in the first place, and later of a bilious fluid. It is brought up with little effort.

Among other features may be mentioned the occasional passage of motions or of urine immediately after the accident; the occasional onset of a rigor at an early period, and the complaint of thirst. It is common that the first words uttered by the patient are for a drink of water.

After the period of the early symptoms most of the cases, especially of the fatal ones, may be placed in one of two categories. (1) Where the hæmorrhage is the most marked feature, the patient remains blanched, faint, and more or less pulseless. His extremities become cold; he is intensely restless, and keeps in incessant movement; the vomiting probably ceases; the abdominal walls probably remain soft and flaccid, and percussion reveals an effusion into the peritoneal cavity. This effusion will be first noticed in the loins, and perhaps equally in the two loins. If the patient be turned over upon one side, the dulness leaves the upper side and becomes greatly increased in the lower loin. It is well to turn the patient first upon one side and then upon the other, as a loaded colon may interfere with the correct appreciation of this physical sign. Blood in

the subphrenic region may be more or less localised. If the patient continues to survive in a case of extensive hæmorrhage, the blood will be found to be mounting up along the anterior abdominal wall as indicated by ascending dulness. The signs of a fatal hæmorrhage become more and more marked until, after a few gasping inspirations, the now unconscious patient dies.

(2) On the other hand, peritonitis may become the most marked feature, and in this case the early symptoms gradually merge into the phenomena of that inflammation. The vomiting increases, the pain is still acute, and the abdominal parietes become hard and hyper-sensitive.

It must not be supposed that in all cases of rupture of viscera the general symptoms always follow these lines. They exhibit the strangest variations. The shock varies greatly, and is by no means to be measured always by the extent of the injury.

Patients with rupture of the liver and with lacerations of the intestine have walked into hospital. In other cases the severe symptoms have been, as it were, postponed, and a patient has died rapidly with acute symptoms many hours after he first sought advice with apparent evidences of some not severe injury to the abdomen.

The symptoms which attend rupture of particular viscera are dealt with later (page 565).

General results of operative treatment.—Siewe gives the following as the result of laparotomy in sixty-two recorded cases of rupture of viscera:—Rupture of intestine, thirty-eight cases with eighteen deaths; rupture of liver, seventeen cases with ten deaths; rupture of spleen, seven cases with six deaths. Total, sixty-two cases, with twenty-eight recoveries and thirty-four deaths.

(b) *With wound of viscera.*—The penetrating wounds of the abdomen may be of almost any kind. The majority would come under the category of stabs or gunshot wounds. In certain instances splinters of wood and sharp fragments of iron have been driven into the abdominal cavity.

The extent of the injury will naturally be subject to infinite variations, and the viscus wounded will obviously vary according to the position and direction of the penetrating body.

The viscera injured.—The structures most commonly injured are the omentum and small intestine. Then in order of frequency would follow the colon, the stomach, the liver, and spleen, and the urinary bladder. A wound to reach the kidney through the abdominal cavity must be very deep. Most of the wounds of the kidney have been inflicted from the loin. Cases have been recorded in which the parietal peritoneum alone has been wounded.

Protrusion of viscera.—Viscera may protrude through the wound in the parietes, and the organs thus exposed may be quite sound, or may, on the other hand, be wounded. The cases in which the wounded part is protruded are attended by a lower mortality than are the cases in which there is no such protrusion.

The parts to escape from the wound are most usually the

omentum or a coil or so of the lesser intestine. The less attached parts of the colon are not infrequently protruded, and the same may be said of the stomach and the urinary bladder. Portions of the spleen or of the liver have been protruded through a wound, but such cases are not common.

Symptoms and method of examination.—In the majority of instances of penetrating wound of the abdomen there is marked *shock*. In the case of homicidal wounds and in alarming accidents much of this may be the effect of terror and panic. This is a matter of some moment, because in cases of attempted murder in which the wound inflicted has been merely superficial, there has been profound shock. Indeed, it cannot be too clearly laid down that the presence or absence of shock is no evidence for or against the existence of penetration in a stab or gunshot wound. Individuals have walked a considerable distance with viscera protruding from a wound in the belly. I have seen a man walk into the hospital and be very anxious to be treated as an out-patient who subsequently died with a penetrating wound involving the bladder and the small intestine. A woman was admitted into the London Hospital under my care who, in a fit of insanity, had opened the sac of a large umbilical hernia. She then pulled out as much intestine as she could reach and tore away some adherent omentum. She lost but little blood and exhibited no symptoms of shock on admission. In spite of the filthy condition of her hands and clothing she recovered without peritonitis.

Vomiting is fairly common in penetrating wounds. It is by no means invariable, and is, indeed, often absent. It is never marked.

Pain is usually present, and is, indeed, one of the most constant phenomena. It is usually described as "burning."

While symptoms of shock are present pain may not be complained of. Even where there is no shock there may be little or no pain.

Internal hæmorrhage may be attended by pallor, dilated pupils, faintness, a failing pulse and dulness in the loins.

With regard to the *local symptoms*. If a coil of intestine or a knuckle of omentum be protruding, or if gastric or fæcal matter or urine or bile be escaping from the wound, there can be no doubt but that the wound has penetrated. As a matter of fact an escape of fluids from wounded viscera is not common. Indeed, it may be said to be exceptional. A wound low down in the abdomen and involving the terminal part of the ileum is perhaps the injury most likely to be associated with an escape of intestinal contents.

There is seldom much external bleeding in cases of penetrating wound. If a large vessel be divided within the abdomen, or if a vascular organ like the liver be extensively wounded, the hæmorrhage is more usually internal. A fatal bleeding may take place into the peritoneal cavity while the escape of blood from the skin wound is in no way noteworthy.

Emphysema about a gunshot wound or a stab of the abdomen is

no evidence that the abdomen has been opened or that the bowel has been injured. If the wound be valvular (whether penetrating or non-penetrating) air may be drawn into the subcutaneous tissue in the movements of respiration.

Air free in the peritoneal cavity is a phenomenon of no value. It is a very rare symptom, and one difficult to appreciate. It is, moreover, likely to lead into error rather than to guide the surgeon surely. Many of the less recent authors laid great stress upon this symptom.

The use of hydrogen gas for the purpose of demonstrating a perforation of the bowel is alluded to on page 568.

The following are the main points to be noted in the *examination of a wound of the abdomen* expected to penetrate :—

The history of the injury, the account given of the circumstances of the wound, and the examination of the weapon may afford distinct evidence upon the question of penetration. If the knife or dagger be found to be soiled with fæcal matter the depth of the injury is at once manifest. It should be noted that a knife may penetrate a considerable depth between the muscles of the abdomen without wounding the peritoneum provided that it follow an oblique or lateral course.

In the case of the majority of gunshot wounds the history alone makes it evident that the lesion has involved the abdominal cavity. There may be two apertures, one of entry and one of exit. The old round musket bullet may, however, penetrate the skin at one point and issue from it at another without having opened the abdominal space. In these cases the bullet is deflected and passes round the body beneath the integuments.

A lobule of protruding fat may readily be mistaken for protruding omentum. Protruded viscera have been reduced into the space between the peritoneum and the abdominal wall. In any case of doubt, regard the lesion as a penetrating wound.

The incision should be most thoroughly examined and be probed as often and as freely as is required to make the diagnosis sure. It was at one time advised that no abdominal wound should be probed, and so it happened that many cases of penetrating wound were overlooked. If a probe be handled with common care it cannot be made to penetrate the sound peritoneum. If the peritoneum be not intact the sooner the circumstance is discovered the better. The wound should be enlarged freely if needed, as it is all-important that the question of penetration should be decided beyond doubt. To enlarge the parietal wound by an inch or so is a matter of little moment, but to overlook a wound of the bowel under the influence of some ancient warnings against the probing of a wound, is a matter of life and death.

In the hands of a competent surgeon it would be safer to make a non-penetrating wound penetrating than to fail to recognise the fact that the abdomen had been opened and a viscus probably injured.

General measures of treatment.—These measures will consist of absolute rest, abstinence from any but the smallest amount of fluid food—and even that should be denied when the stomach is wounded or when vomiting persists—and the use of opium to allay pain and of warmth to counteract shock.

The wound is enlarged to the extent necessary, and is well cleaned; all bleeding made evident is arrested, and any protruded viscus—if unwounded—is cleansed and reduced. Care should be taken that the reduction is complete. If a wounded viscus has to be sought for, the original wound may be enlarged should it be conveniently placed. In many instances, and in most cases of gunshot wounds, it is better to make an incision in the median line and to deal with the damaged parts through that cut. It has been shown that in gunshot wounds involving the lesser intestine it may be expected that on an average four to five perforations of the gut will be found in each case. The lesion when discovered is to be dealt with in the manner described in subsequent sections.

General mortality.—Penetrating wounds of the abdomen are very fatal, although not so fatal as ruptures of the viscera. It has been estimated that in gunshot injuries the death-rate is nearly 90 per cent., and that in stabs of the abdomen the mortality is about 80 per cent. Wounds of the small intestine and of the gall bladder are among the most fatal injuries. When the colon is involved, recovery with a faecal fistula is estimated to take place in some 20 per cent. of the cases. Recovery has taken place in not a few cases of wound of the stomach, a temporary or permanent fistula resulting in most instances. Wounds of the liver and spleen are liable to cause death from bleeding, although many cases of recovery from incised wounds of these organs are recorded. A remarkable case of a harpoon wound of the liver is alluded to on page 571.

Operative measures in the treatment of gunshot and stab wounds of the abdomen have been attended with favourable results, the issue being in great part dependent upon the promptness with which the operation is carried out. The actual mortality of these operations is difficult to arrive at, owing to the fact that successful cases are more uniformly recorded than are the unsuccessful cases. The mortality after operations for gunshot wound has been estimated at over 60 per cent., and after stab wounds at about 40 per cent.

Rupture or wound of the stomach. Rupture.—This is usually produced by a sudden, well-localised, and violent blow, one of the commonest causes being a kick from a horse. A laceration is more likely to occur if the stomach contain solid matter—as just after a meal—than when the organ is empty. The rupture may be partial only, and in such cases the peritoneum may escape. This is demonstrated by cases in which a cicatricial stricture about the pylorus has developed after a violent blow, but in which no marked peritonitis has been manifest. As a rule, however, the rupture concerns all the coats, and is said to be most common near the pylorus

and about the greater curvature. The stomach has been ruptured from within during the process of washing out the viscus. In such cases the walls of the organ were no doubt diseased.

The *symptoms* are those already described (page 561). Shock is nearly always marked. Vomiting is uncommon, and when present blood may be noticed in the ejected matter. There may be free air in the abdominal cavity, and the liver dulness may disappear. There is much burning pain over the stomach, and often much thirst. The abdomen is at first soft, and death has in many instances taken place in twelve hours. In the large proportion of the cases of complete rupture the patient has not lived more than forty-eight hours.

The *treatment* consists of absolute rest, the avoidance of all food by the mouth, the application of warmth, and the administration of morphia hypodermically to relieve pain. Thirst is relieved by rectal enemata of warm water. If the surgeon have reasonable grounds for believing that the stomach is ruptured, the abdomen should be opened in the median line, and the perforation sought for. This can hardly be done until the more grave evidences of shock have passed off. The parietal wound must be enlarged as required. The rent in the organ is closed by a double row of sutures—a continuous suture of the mucous membrane, and an interrupted suture of the serous and superficial muscular coat. When the rupture is on the posterior surface of the stomach, the closure of the rent is very difficult, and it becomes necessary to open up the small omentum. The abdominal cavity should be freed of any gastric contents by sponging, or, if need be, by irrigation with a warm sterile 6 per cent. salt solution. If there be any doubt as to the stability of the suturing in the stomach, or of the cleansing of the peritoneum, a gauze drain may be inserted down to the stomach wall. In other cases the parietal wound is closed.

Wound.—There is seldom much difficulty in the way of diagnosis. The position of the wound in the parietes is of much value. There is seldom great external bleeding, and seldom any escape of gastric contents from the surface wound. *Hæmatemesis* is common. The general symptoms are those of penetrating wound (page 563). The treatment is identical with that advised in the previous paragraph. The existing incision may be enlarged, although a fresh median incision will usually be found to be more convenient. In gunshot injuries there will commonly be two wounds in the stomach, one on the anterior and the other on the posterior surface. The closure of the latter lesion is very difficult. Artificial inflation of the stomach through the œsophagus may be employed to demonstrate the existence of a second opening.

Rupture or wound of the intestine. **Rupture.**—The part of the intestinal canal which is most often the seat of rupture is the jejunum, next in order comes the ileum, then the duodenum, and lastly the colon. In 113 cases of rupture of the bowel collected by Curtis, 109 concerned the small intestine and only 4 the large. In 16 per cent. of all cases the rupture of the bowel is complete, in the

remaining cases (84 per cent.) it is incomplete. It is rare for the bowel to be torn in more than one place. The hole made varies in size, the average length being about an inch. It may be a mere pin hole. The bowel wall around the rent is usually damaged and unsound. In about 70 per cent. of the cases there is an escape of faecal matter into the peritoneal cavity.

There is seldom much hæmorrhage. Now and then (in about 15 per cent. of the cases) there is a rent in the mesentery. In some cases of rupture of the colon the escape of fæces may be extra-peritoneal.

The bowel is not "burst," but is torn by contusion. It is in fact the seat of a contused wound. The ease with which it is torn is influenced by the degree of its distension and by the solid character of its contents. If the bowel be filled with flatus only, it is more likely to escape injury.

The duodenum may be ruptured over its non-peritoneal surface, and a post-peritoneal abscess may follow, which may extend along the spine and lead to emphysema of the abdominal wall.

A common cause of rupture of the bowel is a kick from a horse; other lesions are represented by blows, by being ridden over, and by falls.

The *symptoms* are those which attend intra-abdominal rupture (page 561). Shock is nearly always marked, and the same applies to vomiting. Pain is practically constant in some degree. There is usually much restlessness. Later, constipation is marked. The abdomen is at first soft, and, later, distended and hard. There may be evidence of effusion, as shown by dullness in the loins. Free air in the peritoneal cavity, and emphysema of the abdominal wall, are two reputed signs of rupture of the bowel which are often alluded to. They are seldom present, and, from a diagnostic point of view, are valueless. Blood in the stools is an exceedingly rare symptom.

Peritonitis soon appears, and the later symptoms are those of that affection. The vomiting is especially persistent, and not infrequently becomes fæculent.

Many anomalous cases are met with. Curtis reports the case of a boy of thirteen who walked a mile after receiving a heavy blow. He died in thirteen hours, and a complete rupture of the duodenum was revealed.

In another instance a lad of nineteen met with a fall when drunk. He was taken into hospital. The next day he got up and walked about, and partook of three meals of milk and broth. He died in twenty-seven hours, and the autopsy showed a complete rupture of the jejunum.

Mortality.—The mortality of rupture of the intestine without external wound is given by Chavasse as 96 per cent. Shock and peritonitis are the two principal causes of death. The average duration of life is only forty-eight hours.

Treatment.—The patient is kept at absolute rest. Morphia is given hypodermically to relieve pain, warmth is applied to the

extremities to overcome the effects of shock, little or no food is given by the mouth, and then only in minute quantities, and in the absence of sickness. Thirst is relieved by hot-water enemata, and great depression by hypodermic injections of strychnia. If the diagnosis be established, or even if it be fairly probable, the abdomen should be at once opened in the median line, the position of the incision being influenced by the site of the blow. Before the operation is commenced the more profound evidence of shock should have passed off.

As soon as the injured gut is discovered it is drawn into the wound. Small perforations are closed by means of Lembert's sutures, a fair amount of the margin of the opening being tucked in or sequestered. The part of the gut which bounds the orifice is usually unsound. In larger rents the margins of the opening may be excised, and the wound then closed by a double row of sutures—a continuous one for the mucous membrane, and a Lembert's suture for the surface. If the rupture be extensive, or if there be several ruptures close together, or if the gut bear evidence of extensive contusion, or if the mesentery be much damaged, the involved segment of gut should be excised. If the patient's condition will admit of it the divided ends of the bowel should be at once united by sutures, or by one of the many mechanical appliances now in use. If the patient is likely to perish if the operation be long continued, then an artificial anus should be established. The better results—so far as statistics go—have attended the cases treated by immediate suture.

When the ends of the bowel are sutured together the line of apposition may be strengthened by omental grafts.

The peritoneal cavity must be cleansed by gentle sponging or by irrigation with a warm sterile .6 per cent. salt solution. Drainage with any form of tube should be avoided, and the abdomen closed whenever practicable. If, however, there is doubt as to the condition of cleanness of the peritoneum, or if the surgeon has any misgivings about his suture line, an iodoform gauze drain may be used, and passed well down to the damaged bowel.

Much time is often lost in searching for the perforation, and some help in finding the lesion may be afforded by distending the bowel with hydrogen gas. This is carried out by means of a tube introduced into the rectum. If there be a rupture of the bowel without a breach in the parietes the abdomen soon becomes distended by the gas. If a wound has been made, the escape of the gas from the aperture in the bowel leads to the detection of the lesion. Pure zinc and sulphuric acid are used for the generation of the gas, which is collected in a rubber bag holding at least four gallons.

Siewe gives the following statistics of the result of operation. Contusion of bowel: 1 case, 1 death. Incomplete rupture of bowel: 24 cases, with 11 deaths. Complete rupture of bowel: 4 cases, with 3 deaths.

Wound.—The part injured is usually the small intestine. Next in frequency come the transverse colon, the stomach, and then

other parts of the colon. The wound may be a mere puncture or an extensive gash. It may divide the outer coats of the gut and leave the mucous membrane intact. So far as prognosis and treatment are concerned it matters little whether the wound is in the long axis of the bowel or transverse to it. The plugging of a small wound in the gut by protruded mucous membrane is seen in experiments upon some animals (notably cats and dogs), but it is a question if it is to be met with in the human subject.

A considerable uncertainty attends the escape of fecal matter from the wound. It may be extravasated from a very small wound, and not escape in one much larger. Fæcal extravasation is less common in wounds than in ruptures of the bowel. Hæmorrhage is more common and more considerable in wounds of the bowel than in ruptures. The blood, like the intestinal contents, is seldom found escaping from the external wound.

The symptoms of the injury may be gathered from what has been already said of wounds in the viscera generally (page 563), and of rupture of the bowel (page 567). The existence of an external wound makes the diagnosis more easy, and treatment more definite.

The treatment follows the lines already indicated in dealing with rupture of the bowel. It remains to be said that as the peritoneal cavity is already opened, the wound should be freely enlarged and the abdomen explored in any case in which the very least doubt exists. The enlarging of the wound adds little or nothing to the gravity of the case. If any viscera protrude, they should be well cleaned, and, if sound, reduced. If the omentum be found to be much engorged by the compression of the margins of the wound, or if it be torn, or wounded, or dirty, the whole segment involved had better be cut away, the vessels ligatured in small clumps, and the stump reduced. The same principles apply to the protruded bowel. If it be uninjured it is reduced; if there be a small wound, that is closed and the gut put back; but if the wound be very extensive, and if the gut have been damaged by long exposure, it will most probably be necessary to excise a portion of the gut and effect immediate union, or establish an artificial anus as circumstances dictate. What has been said of the treatment of ruptures of the gut applies with obvious modifications to the treatment of the wounded bowel found within the abdomen. A cutting away of the margins of the wound will seldom be required. A double row of sutures should be used whenever possible. A better result would appear—from statistics—to have attended immediate suture as compared with the artificial anus. The cleansing of the peritoneal cavity and the question of drainage have been alluded to in the paragraph on rupture of the gut (page 568).

The mortality after this injury is high, but it is lower than that after rupture of the bowel. The results of operation have also been more satisfactory, and attended with a lower death-rate. One common cause of death after operation is the overlooking of an aperture in the bowel. In a deep stab the gut may be punctured

in many places, and when the abdomen is opened only the more superficial one may be discovered.

Rupture or wound of the liver. Rupture.—The lesion is brought about by sudden blows and by falls, and occasionally by means of the ribs when they are broken. The tear is usually in the right lobe, and upon its diaphragmatic surface or at its margin. In some cases the injury causing the tear has been apparently slight, as, where the organ has been ruptured in a delirious patient, from falling out of bed. The rent in the liver is usually irregular and the sides of it are uneven. The rupture may assume a stellate form. There may be a mere crack upon the liver surface, or a rupture so deeply extending as to isolate a portion of one or other lobe. That the liver substance may be to some small extent ruptured without breach in the serous covering or capsule is undoubted. Certain of the cases which recover may be of this kind. Experiments upon animals show that a very considerable portion of the liver may be pulped and the animal yet survive. Both from experiments, and from experience in the human subject, it has been shown that lacerations and wounds of the liver heal well. In instances of severe fracture of the ribs with recovery, a portion of broken rib has been driven into the liver.

The *symptoms* are those of severe intra-abdominal injury (page 561), together with certain special features, such as the site of the blow, which point to the liver. There is usually marked collapse, pain, shallow breathing, vomiting, and tenderness over the liver. The abdomen is, as a rule, flaccid at first, and tense and perhaps distended later. There may be much pain in the back. The patient is restless and infinitely distressed. There may be evidences of internal hæmorrhage, as shown by increasing anæmia, faintness, pulselessness, and dulness in the loin (mostly in the right), which disappears when the patient lies upon the opposite side. The area of dulness about the liver may be increased. Jaundice is not usual and does not appear, when met with, until some time has elapsed.

In some cases sugar in the urine has been noticed.

Bleeding is not so profuse as may be expected, and in some cases is comparatively slight. I opened the abdomen in the case of a woman delirious with puerperal fever, who had fallen out of bed, and, as the laparotomy revealed, had sustained a rupture of the free edge of the liver some two inches in depth. There was but little blood in the abdominal cavity, and what there was was coagulated and formed a mass close to the seat of injury. There was no blood in the loins.

Mortality.—In many of the severer cases death follows from shock. Others die of hæmorrhage, and a smaller proportion of peritonitis. In exceptional cases an abscess (localised peritonitis) has formed. Edler gives the following as the mortality in 543 cases of injury to the liver:—contusions: mortality, 85·7 per cent.; gunshot wounds, 55 per cent.; other wounds, 64 per cent. The death-rate at the present day is not so high as this.

In most of the fatal cases death occurs in a few days. Martel

quotes a case in which the patient lived fifty days, and Erichsen the case of a man who died at the end of sixteen days of peritonitis, and in whose abdomen were found 240 ounces of bilious fluid.

Treatment.—The routine measures of absolute rest, restricted diet, morphia if needed, and warmth while shock lasts, are applicable to all cases. The difficulty is to decide upon the need for operative interference. In the first place, many cases marked by quite severe symptoms recover in due course. On the other hand, the results of laparotomy have so far not been very brilliant. In a case of doubt the balance should incline in favour of operation. The abdomen should be opened over the injured spot if it be indicated, and failing such guidance, in the right semilunar line. An actually detached piece of liver should be removed. A rent in the liver may be closed by silk sutures passed with curved needles. The sutures, however, obtain very little hold, and are useless if much strain be put upon them. Bleeding which may be brisk often becomes slight and insignificant after the lacerated part has been exposed for some time. Ligature is useless in the arrest of bleeding. The best measures are sutures deeply placed, and so inserted as to close the gap, and failing that the stuffing of the rent with iodoform gauze, the end of the plug being brought out through the parietal wound.

The actual cautery has been used, but it is not to be recommended. All blood clot should be removed, but there can be little need to irrigate the peritoneal cavity.

If the rent in the liver is closed with sutures, and if all bleeding has ceased, and the serous cavity is clear, no drain is needed, and the parietal wound may be closed. Should the rent be imperfectly closed, or the bleeding be only partly checked, or much blood be left in the peritoneum, a gauze drain should be employed. A rubber or glass drainage-tube is to be avoided.

Wound.—The position of the parietal wound and its direction will afford fair grounds for a correct diagnosis. There is more bleeding, both from the surface wound and into the peritoneal cavity, in incised and punctured than in gunshot wounds. An escape of bile is rare. It has been noted in about 40 per cent. of the gunshot injuries. It may not escape at once, but be observed some two to five days after the injury should the patient survive.

The *symptoms* of these injuries need not be dwelt upon. (See page 563 and the preceding paragraphs.)

It is remarkable from what grave injuries of the liver recovery is possible. One of the most marked cases is reported by Dr. Gann.* It concerned a man of twenty-eight, who had a harpoon driven through the whole thickness of the right lobe of the liver, so that it projected at the posterior border. The blade was seven inches long, and had two barbs. Laparotomy was performed twenty-eight hours after the accident, and the harpoon could only be extracted after free incisions had been made into the liver substance. The very

* *Lancet*, June, 1894.

free bleeding ceased spontaneously in thirty minutes. The peritoneal cavity was washed out and drained. A speedy recovery followed.

The *treatment* is sufficiently indicated in the paragraph on rupture of the liver (page 571). A better result should attend the treatment of wounds of the organ, and the suture should be more frequently employed.

Injuries to the gall bladder.—The injury most often met with in connection with the biliary passages is rupture of the gall bladder. This lesion, however, is quite rare when the wall of the viscus is healthy. The whole gall bladder may be torn away from the liver. The duct most commonly ruptured is the cystic duct, and after that the hepatic, and then the common duct.

All kinds of wounds of the biliary passages have been recorded ; they are very fatal injuries.

Injuries to the biliary passages are very difficult to diagnose when seen shortly after the accident. Peritonitis may follow, and the escaping bile may become encysted, until there is a vast accumulation. Abscess may form. In the majority of instances death is from peritonitis ; in some from biliary fistula.

A small wound or tear of the gall bladder may be closed by a double row of sutures ; but if the viscus be extensively injured it is better that it should be entirely removed.

When the cystic duct is damaged, it is necessary that the intestinal end of the tube should be carefully closed, and the gall bladder removed. In division or in rupture of the hepatic or common duct, little or nothing can be done beyond filling the wounded area with an iodoform gauze drain, which is brought out through the skin wound. In almost every instance it must be expected that an intractable biliary fistula will follow.

Rupture or wound of the spleen.—Rupture of the spleen is often associated with fractured ribs. In about 30 per cent. of the recorded cases the ruptured spleen was enlarged—in most cases as the result of malaria. In such instances a tearing of the organ may follow a comparatively slight injury. Wounds of the spleen have been for the most part gunshot wounds. A part of the spleen may be protruded through the laceration in the side, and may become strangulated, and as a result inflame or necrose. A bullet has been found *post mortem* firmly embedded in the spleen, the injury having been received many years before death.

Hæmorrhage is the principal cause of death in injuries to the spleen. Fatal bleeding has followed the puncture of the organ with a Pravaz's syringe (Ewald).

The general mortality of injuries to the spleen has been placed by Edler at 83·3 per cent. ; the death-rate in uncomplicated cases being as low as 65 per cent. Rupture of the spleen is the most fatal of these injuries, then follow gunshot wounds, whilst the lowest mortality has attended punctured wounds. Rupture of an enlarged spleen would appear to be less fatal than rupture of a normal viscus.

The *symptoms* of these injuries call for no special description. (See page 561 and page 563.)

The position of the wound, or the situation of the blow and the detection of fractured ribs, would all serve to direct attention to the spleen. The probability of internal hæmorrhage is also to be borne in mind. Shock is usually marked.

The *treatment* differs in no essential particular from that described in connection with like lesions elsewhere in the abdomen. (See page 569 and page 571.) The application of ice over the splenic region is said to have had an effect upon the hæmorrhage, but such a measure could not be employed while symptoms of shock are present.

If a rupture of the spleen be suspected, the abdomen should be opened. If a wound exist, it should be freely enlarged. All blood clots should be removed. Hæmorrhage is to be dealt with in the manner described in speaking of the liver. Rents in the spleen may possibly be closed by deeply-placed silk or catgut sutures. Failing such a measure, the rent should be stuffed with an iodoform gauze-plug, which is used as a drain.

If the spleen be very extensively damaged, it must be removed. Nussbaum has collected 26 cases of splenectomy for injury with 16 recoveries. Ledderhose gives 10 cases with 10 recoveries. Damaged portions of the spleen have been removed. The best measure is incision, followed, when possible, by suture; and when not possible, by plugging with gauze. If the spleen be prolapsed, and, as is almost inevitable, much damaged, it should be removed. Moreover, if a portion be protruded and be injured or strangulated, it should be excised. An incision is to be recommended as just mentioned. There is little to commend the actual cautery, and still less the ligature. Should the protruded part be quite sound, it will, of course, be sufficient to enlarge the wound and reduce the organ.

AFFECTIONS OF THE STOMACH.

Cancer of the stomach.—Cancer is very common in the stomach. No abdominal viscus is so frequently affected with this disease. The cancer is nearly always primary. It assumes the form of an epithelioma, and imitates in its structure the tubular glands of the organ. It commences in the deeper layers of the mucous membrane, and spreads readily in the very lax submucous tissue. Cancer of the stomach is more common in males than in females, and the average age at which it appears is 50. In more than 60 per cent. of all cases it attacks the pylorus, and next in frequency the lesser curvature of the organ. Like other epitheliomata, it is very apt to ulcerate. The growth is prone to spread to the peritoneum, and especially to the omentum, and also to the liver, the pancreas, and the neighbouring lymphatic glands.

Perforation into the peritoneal cavity is rare, and occurs in only some 3 per cent. of the cases. In about the same proportion of

cases a perforation takes place into the colon, producing a gastro-colic fistula and some temporary relief.

The *symptoms* may be considered as they would be presented in the common form, *i.e.* in cancer of the pylorus. There is, in the first place, dyspepsia, with flatulence and discomfort after food, and a rapid loss of appetite. Then come a gnawing pain in the stomach, and usually pain in the back. Nausea is marked, and vomiting becomes more and more prominent. The patient is sick at long intervals, bringing up each time very large quantities of sour, fermented fluid. This represents the material which has accumulated in the stomach since the last act of vomiting.

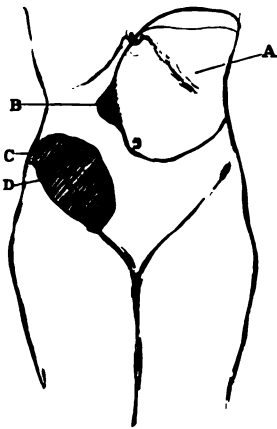


Fig. 771.—A, Area occupied by a dilated stomach; B, a common position for the tumour in cancer of the pylorus; C, the area of dulness in a case of perityphlitis; D, incision for opening a perityphlitic abscess or for exposing the appendix.

Hæmatemesis is very usual, and may be alarming. The patient wastes rapidly, and becomes extremely emaciated. The stomach is dilated, and may attain enormous dimensions. Its outline can, as a rule, be readily made out. It often feels like a loose, thin-walled bag filled with water. A tumour is commonly to be detected. It is below the normal position of the pylorus, having been dragged down by the dilating organ (Fig. 771). It is very often met with just above and to the right of the umbilicus. It is usually tender to pressure. It is sometimes movable, but is more often fixed.

The average duration of life in cancer of the stomach is twelve months. When the cancer is at the cardiac orifice, the symptoms are rather those of stricture of the gullet, and the stomach is contracted. The symptoms above described are liable to some variation.

Treatment.—The medical treatment of these cases need not be considered. The surgical measures which have been employed—assuming the cancer to be at the pylorus—are the following: (1) gastrotomy, with the use of the curette (page 577); (2) resection of the pylorus (page 578); (3) gastro-enterostomy (page 578). See also jejunostomy (page 579).

Non-malignant strictures of the pylorus.—These are of less frequent occurrence than the cancerous stricture. They are met with in adults, but, as a rule, at a somewhat younger age than is usual in cancer. The causes are ulcer of the stomach, which has healed and led to cicatrization; injury to the stomach, such as may follow a well-localised and sudden blow; and the cicatrix resulting from the swallowing of a caustic fluid. (The contraction in this last-named case is more commonly met with at the cardiac orifice.)

There remain a few examples in which none of the above-mentioned causes appear to hold good, and in these there is found an enormous ring-like hypertrophy of the circular muscle fibres of the pylorus.

The symptoms produced are similar to those which attend cancer of the pylorus. The wasting is less, the pain is less; blood is very seldom noted in the vomit, and the progress of the case is very much less rapid.

The surgical measures available for treatment are (1) Loreta's operation (page 579); (2) pyloroplasty (page 579); and (3) resection of the pylorus (page 578). See also gastro-enterostomy (page 578).

Perforation of the stomach.—Perforation of the stomach depends—in all but a few exceptional cases—upon simple ulcer of the stomach. Ulcer of the stomach is more common in females than in males, in the proportion of three to two. The largest number of cases are met with between the ages of 20 and 30. The usual position of a gastric ulcer is on the posterior wall of the pyloric segment of the stomach, and near to the lesser curvature. The least frequent position is the greater curvature or the fundus. Ulcers are comparatively rare on the anterior wall. Perforation is estimated to take place in about 6 per cent. of the cases of gastric ulcer, owing to the protected position of the posterior wall of the stomach; and as that surface lies easily against an opposed serous surface, perforation of the posterior wall of the stomach is rare. The majority of the perforations are on the anterior wall.

The *symptoms* are those of sudden peritoneal injury, with rapidly appearing peritonitis. Death may occur in six or eight hours. In the majority of the fatal cases—and the lesion is exceedingly fatal—the patient lived from eighteen to thirty-six hours.

Treatment.—If the perforation be diagnosed, or even if it be on good grounds suspected, the abdomen should be opened either in the median line—just below the ensiform cartilage—or in the left semilunar line. The operation may be undertaken as soon as the more marked symptoms of shock have passed away. The incision should be free. The perforation is sought for. Sponges are used to prevent extravasation. If the aperture be found, a small portion of the stomach wall around the hole should be excised, and the gap thus made closed by a double row of sutures—a continuous suture for the mucous membrane, and a row of Lembert's sutures for the surface coats of the viscus.

The peritoneal cavity must then be cleaned out, and a gauze drain inserted in any instance in which the surgeon is not satisfied with his sutures or with the cleanliness of the peritoneum. If the perforation be upon the posterior surface of the organ, the closure is very much more difficult, and the great omentum will need to be divided, in order to bring that surface into view.

This operation has been many times performed, but on most occasions at too late a period. The results were for a long time most discouraging; but quite recently many successful cases have

been recorded which fully justify the surgeon in his attempts to deal with this very fatal complication of gastric ulcer.

Gastric fistula.—This condition is exceedingly rare. A fistula over the gastric region through which some of the contents of the stomach are discharged may result from (1) injuries, especially gunshot injuries, as in the well-known case of Alexis St. Martin; from (2) simple ulcer of the stomach—a most rare occurrence; from (3) cancer of the stomach. In the last instance, which is also most rare, the fistula has probably been brought about through a perigastric abscess.

In certain of the non-malignant cases the fistula may be closed by a plastic operation. The soft parts around the cutaneous opening, around the opening into the stomach, and around the canal which connects them, are freely cut away. The stomach is freed and the gap in it closed by a double row of sutures. The aperture in the abdominal parietes is then sutured. This operation—which is not so simple as it sounds—has been performed with success in one or two instances. (*See also page 594.*)

Foreign bodies in the stomach.—The list of foreign bodies which have passed through the alimentary canal is most remarkable, and includes such articles as plates of teeth, nails, forks, spoons, knives, knife handles, wire, scraps of tin and iron, broken crockery, glass, etc. How some of these bodies have passed the pylorus and the ileo-cæcal valve is an anatomical mystery, but it is a fact that most of the foreign bodies swallowed are passed per anum in due course. (Note the case alluded to on page 638, Fig. 781.) Substances so passed generally remain in the stomach two or three days, and appear in the motions in from seven to fourteen days. The foreign bodies which are most apt to lodge in the stomach are irregular substances like plates of false teeth, or long narrow articles such as pencils and nails, and also bodies formed by the gradual accumulation of particles of hair or husks. Hair balls of great size have been met with in the human stomach.

If the foreign body be retained, the symptoms are those of dyspepsia, pain in the stomach, tenderness over the stomach, nausea, some vomiting, occasionally hæmatemesis, wasting, and often a considerable degree of depression.

The only satisfactory treatment of a retained foreign body is by gastrotomy. (*See below.*) This operation has been performed from three days to two years after the foreign substance has been swallowed. Twenty-eight recorded cases of gastrotomy for retained foreign body show twenty-four recoveries and four deaths.

An early operation is only called for in the case of sharp-pointed substances which are giving great distress, or are causing hæmorrhage. It is well in other cases to allow some time to elapse and to await the development of symptoms.

Operations upon the stomach. Gastrotomy.—This operation involves merely a cutting into the stomach. It is employed in the removal of foreign bodies and in the curetting of cancer. In either case the stomach is washed out before the operation. The

incision is made either in the linea alba, in the left semilunar line, or in a line parallel to the margins of the left ribs. When a foreign body is to be felt the incision may be made directly over it. The abdomen is opened, the stomach is identified and seized with toothed forceps, two loops of strong silk are then passed through the wall at some little distance apart, and by means of these the stomach is held against the parietal wound. The area of the operation is surrounded by a packing of sponges to prevent extravasation. The stomach is opened in the direction of the blood-vessels, *i.e.* transverse to the long axis of the organ. The divided mucous membrane is seized and the opening exposed.

The removal of the foreign body is often difficult, it being found to be buried in the mucous membrane and covered with granulations. Through an incision in the stomach impacted foreign bodies have been removed from the cardiac end of the œsophagus. To effect such removal the entire hand has been introduced through the stomach wound.

In treating pyloric cancer by curetting, a sharp spoon or curette is introduced through the opening in the stomach and the soft cancer material—which concerns at first only the mucous and sub-mucous layers—is scraped away. Bleeding must be free. The measure can be palliative only. It has the effect of entirely emptying the stomach, of reopening the narrowed pylorus, and of possibly hindering the growth of the cancer. It gives, therefore, temporary relief.

Gastrostomy.—As the term indicates, this operation involves the making of a mouth or stoma in the stomach. It has been carried out in cases of stricture of the gullet, both cicatricial and malignant, in cases in which the gullet is obstructed by a tumour without its walls, and in certain cases of cancer of the pharynx. The operation is performed in two stages. The stomach is exposed by an incision which is usually placed parallel to and near by the margin of the left ribs and just below the liver. The viscus is secured to the edges of the parietal wound by many sutures, but is not opened. The opening is deferred for from some hours to three or four days. Through the little opening made the patient is fed.

The feeding is difficult and the general after-treatment of the case complex. The mortality of the operation is very differently given by those authors who have collected the recorded cases. One author (Zesas) gives the death-rate as 84 per cent. in malignant cases and 60 per cent. in non-malignant stenosis. Another writer (Gross) gives the general mortality of the operation as 30 per cent. Gastrostomy, if performed on a healthy person, would probably be attended by no higher immediate mortality than 3 or 4 per cent. The great death-rate is therefore in large part due to the lamentable state of the patient at the time of the operation. The great majority of the fatal cases fall within the first fortnight after the operation. The average duration of life after operation in the cancer cases has been estimated at thirty-three days, and in the non-malignant cases

at about three hundred days. Out of one hundred and six cases of operation for cancer only twenty-five were alive from three to eight months after the opening of the stomach. To insure any degree of success the operation must be done early, must be done in two stages, and must be followed by the most careful after-treatment. At present the best that can be said of the operation in malignant cases is that it makes the method of dying more easy—and often more speedy.

Resection of the pylorus.—The pyloric end of the stomach has been cut away in cancer, and in a few cases of cicatricial stricture.

The stomach having been washed out, the abdomen is opened either in the median line or by an incision directly over the tumour. The diseased part is well isolated and then cut away. The general peritoneal cavity is shut off from the area of the operation by a ring of sponges. The opening in the stomach is then closed by sutures until it is the size of the lumen of the divided duodenum. The two viscera are finally united by a double row of sutures. The operation may occupy one hour and a half.

In eight cases of pyloric resection for cicatricial stricture five patients made a good recovery, and three died. In sixty-six examples of the operation for cancer collected by Kramer, fifty died very soon after the operation, sixteen recovered, but had more or less speedy recurrence. The most fatal cases were those in which extensive adhesions existed. There is nothing to recommend the operation in malignant disease, and it may be replaced by better methods in dealing with non-malignant cases.

Gastro-enterostomy.—This operation aims at establishing a fistulous opening between the stomach and the small intestine in cases of cancer of the pylorus. The operation has also been carried out in examples of non-malignant stricture in which other methods were considered inadvisable, or had been tried and failed. The stomach is washed out, and the abdomen is opened sometimes by a median incision, and sometimes by an incision parallel to the margins of the left ribs. The omentum is pushed aside and the nearest available loop of the jejunum is brought up to the stomach, the stomach and the bowel are opened under suitable precautions, and the two viscera are united around the opening made. The union may be effected in various ways, by direct suturing, or by one of the many mechanical appliances, such as the "plates," "bobbins," and "buttons," which are now in use. Of these, the apparatus known as "Murphy's button" appears to have been the most successful, as it is certainly the most easy to apply.

The mortality of the operation as drawn from collections of published cases is given at from 35 to 55 per cent. In one very successful case (Barker's) the patient lived twelve months in comparative comfort. In the majority of the cases the relief has been but temporary, and there is a marked tendency for the artificial opening to become more and more narrowed.

Duodenostomy and jejunosotomy.—In these measures an artificial opening is made in either the duodenum or jejunum, and through this "stoma" the patient is fed. The operation has been carried out in cases of pyloric cancer, in the place of the measures already described. It has not met with success.

Loreta's operation.—This method is applied to cases of non-malignant stricture of the pylorus or cardiac orifice. The stomach is opened, and the narrow orifice is dilated by means of suitable dilating instruments or the finger.

The opening in the stomach is then closed.

The operation has been attended with considerable temporary, and with fair permanent improvement. Relapses are, however, not uncommon. The death-rate in twenty-eight cases is given as 46 per cent.; at the present time it may be taken as lower than that.

Pyloroplasty.—This operation is used to relieve cicatricial stenosis of the pylorus. The stomach is exposed, and a cut is made along the anterior wall of the pyloric segment, and is carried about one inch along the duodenum, and one inch along the front of the stomach. It is in the long axis of the gastro-duodenal canal, and divides all the coats, and of course completely severs the stricture. The wound thus made is well opened, and its margins are then united (by a double row of sutures) transversely to the long axis of the stomach and duodenum. Thus, if the wound be described as horizontal, the sutured line is vertical. By this measure the stricture is divided and the pylorus greatly widened.

It has been performed in at least eight cases, and has been attended with decided success. One advocate of the operation writes: "Recurrence of the stricture is a physical impossibility." This statement remains to be demonstrated.

AFFECTIONS OF THE LIVER.

Abscess of the liver.—Abscess in this organ may be primary, as when it follows injury, and when suppuration occurs in hydatid cysts. As a rule, however, it is secondary, and in reality pyæmic, the infection of the blood being limited to the portal system. Abscess of the liver may be met with as a rare sequela of ulcer of the bowel, especially of the colon or rectum. It is more common as a result of tropical affections of the intestine, and the great majority of the abscesses which come under the surgeon's notice are "tropical abscesses." Metastatic abscesses are common in the liver in general pyæmia, but are in such circumstances beyond the reach of treatment. The tropical abscess will be taken as the type.

Tropical abscess.—There is nearly always a history of dysentery, and often of exposure, hardship, or intemperance. The trouble is more common in Europeans than in natives, in males than in females, and in adults than in young people. The collections of pus may be multiple or single. If single, the most common site is the hinder part of the right lobe. Multiple abscesses tend to become

single by coalescing. The abscess may attain enormous proportions, and contain pints of pus. The walls are irregular and full of bags and pockets, and are covered with a tenacious muco-purulent material.

The contained pus is thick, glutinous, and chocolate-coloured. It may be paler and comparable in colour to strawberry cream. It often contains blood-clots and fragments of necrosed liver tissue. Pyogenic cocci are usually present, and often the *amœba coli*.

The abscess in its progress may burst in one or other of the following directions, placed in order of their frequency:—(1) into the right lung; (2) into the bowel; (3) upon the surface of the body. Less frequently, it may burst into the peritoneal or pleural cavities.

The *symptoms* are usually insidious. There are loss of appetite, malaise, weakness, fever of a hectic type, chills or rigors, profuse night sweats, pain over the liver and in the right shoulder. Vomiting is uncommon, jaundice is still rarer; the bowels are as a rule loose, a dry cough is frequent. The abdomen appears full, and its movements are restricted; the liver area is enlarged, and there may be œdema of the intercostal spaces. There is probably tenderness on pressing over the liver. The symptoms show great variation, and may not be marked until the abscess is of large size, or until it has burst into the lung.

The mortality of tropical abscess is estimated at from 70 to 80 per cent. (Manson). Death is usually from general pyæmia or from profound hectic. If a timely operation be carried out, half of the cases so treated recover, the prospects being better when the abscess is single.

If the abscess burst in any of the three directions indicated the prognosis is very bad, but is not entirely hopeless.

Treatment.—If an exploratory aspiration be considered necessary, the needle should first be thrust in the seventh or eighth space on the anterior axillary line. If no pus be reached, it should, in the second place, be introduced just below the ribs on the nipple line, and if no indications follow it should, in the third place, be introduced behind just below the edge of the lung, in a line continued down from the tip of the scapula (Manson). The only surgical treatment is early and free incision, thorough drainage, and the utmost care in the after-treatment to keep the region surgically clean. If an external opening already exist it should be well enlarged, and counter-openings made if needed. When no opening exists, the incision must be made in what appears to be the most advantageous position. This will be decided by the aspirator or by redness of the skin, or by swelling. If any swelling exist, the most prominent part of it should be selected. Adhesions will very commonly be found to attach the liver to the parietes at the point selected. In such case the abscess can be at once opened. If no such adhesions exist the operation should be divided into two stages. In the first the liver is fixed to the margins of the parietal wound. When—as is frequent—this is

not possible, a plug of iodoform gauze is introduced and retained in position until adhesions form.

Should the case be urgent, and no adhesions exist, the surgeon must do his best to limit extravasation of pus by means of sutures and gauze plugs. In order to open the abscess a considerable thickness of liver tissue may have to be cut through. A counter-opening may be sometimes indicated. The septa of the abscess cavity should be broken down. Search should be made with the finger for other abscesses. The larger the abscess the more likely is it to be single.

Very free drainage is required. I use tubes with a lumen of one inch diameter. The after-treatment consists of frequent irrigation with some antiseptic solution (creolin 1 in 600 answers well), the prevention of all bagging of pus, the attaining of perfect cleanliness, and the supporting of the patient's strength.

Hydatids of the liver.—The origin of the hydatid cyst has been considered on p. 321, Vol. I. The liver is the organ most commonly affected with this parasite. There is, as a rule, only one cyst, but there may be as many as ten.

The cyst may be found in any part of the liver; it is most common in the right lobe and near the capsule, and its usual tendency is to grow downwards. The liver tissue around the cyst atrophies from pressure. The cyst may remain small and quiescent. It may, on the other hand, attain such enormous dimensions as to fill the whole of the abdomen. It may induce peritoneal adhesions in its progress, but this is not usual.

The cyst may exist for years and give no trouble. It may even undergo retrograde and degenerative changes and practically become effaced. It may cause death from pressure. It may become inflamed and suppurate. It may burst into the pleura or lung, or into the alimentary canal. Very rarely has it burst into the pleural or peritoneal cavity, and, most infrequently of all, through the skin.

The *symptoms* are mostly negative. The tumour, when large enough to be appreciated, is in the right hypochondriac, epigastric, or umbilical region. It is even, globular or largely lobulated, smooth, firm, and elastic. If not too tensely filled, and if conveniently placed, fluctuation is evident. If one hand be placed upon one side of the tumour, and if the other side be tapped sharply with the finger of the disengaged hand, a particular thrill or shudder may sometimes be felt to pass across the cyst. This is the hydatid fremitus. It may be compared to the impression that purring will convey to the ear, and that the sight of trembling jelly will convey to the eye. It is by no means constant and by no means diagnostic, as it may be felt in any thin-walled cyst containing thin fluid. It is needless to say that such cysts are mostly hydatid. In common with other swellings of the liver the mass descends on inspiration.

The liver may be pushed forwards, upwards, or downwards. As a rule there is no pain, no fever, no wasting, no jaundice. The tumour, if large, is merely burdensome. The patient may present the features of perfect health. Certain pressure effects may be produced when

the cyst is large. Among these may be mentioned displacement of the heart, dyspnoea, vomiting, jaundice, constipation, ascites, and œdema of the legs.

Treatment.—Very little substantial or certain benefit has attended the treatment of hydatid cysts by puncture or by electrolysis. The measure which has met with the most success is the treatment by incision and drainage. What has been said of the surgical treatment of abscess of the liver applies—with minor and obvious modifications—to hydatid cysts. The incision must be made over the point where the tumour most distinctly presents, due regard being given to the questions of ease of access and efficient drainage. The operation is possibly most safely performed if carried out in two stages. When adhesions exist the cyst can be evacuated at one operation. As little harm has followed the entrance of a small amount of clear cyst fluid into the peritoneal cavity, most surgeons disregard the method by two stages. In any case it is desirable that the margins of the opening made in the cyst should be sutured to the margins of the parietal wound. The peritoneal cavity is protected—if no adhesions exist—by a packing of sponges. The contents of the cyst should be well evacuated. The opening should be free, and the drainage-tube employed be large. For cysts of any magnitude a tube with a diameter of one inch is not too large. In the after-treatment care must be taken to provide perfect drainage, a perfect washing out of the cyst, and perfect cleanliness. The majority of the cases do well, although the after-treatment may be tedious. In some a long-continued suppuration supervenes, which may lead to an intractable sinus on the one hand, or hectic symptoms on the other. Hydatid cysts of the liver have been successfully evacuated through the pleural cavity, the incision passing through an intercostal space and the diaphragm.

In one or two instances small hydatid cysts of the liver have been dissected out *en masse* with success.

It may here also be said that small **cancerous tumours** have been cut away from the liver, and the patient has survived the operation. König removed a large **cystic tumour** ("cystic adenoma of the biliary passages") from the liver with success.

AFFECTIONS OF THE GALL BLADDER.

Gall stones.—These concretions—which contain from 70 to 80 per cent. of cholesterin—are very common. They are more frequently met with in females than in males, in the proportion of five to two, and occur for the most part in patients who have passed middle life. Before thirty they may be said to be uncommon. The stones vary in size from fine shot to a duck's egg. If very large they are usually single. If small they are usually multiple and faceted by mutual pressure. In number there may be as many as 200 or 300.

Gall-stone colic.—When a gall stone passes into a duct it

produces the symptoms of gall-stone colic. The patient is seized with sudden and severe pain in the region of the liver, or more definitely of the gall bladder. The pain radiates to the back of the scapula. There is more or less collapse. Vomiting is usual. There is some tenderness over the liver, with some sense of fulness and some rigidity of the muscles. If the stone block the cystic duct there is no jaundice; if it obstruct the common duct there is jaundice, which will depend upon the duration and degree of the obstruction.

It will be evident that gall-stone colic will be liable to great variations, depending upon the size of the stone, etc.

The attacks may last a few minutes or a few hours, or even extend to a day or more.

Small stones will probably only give pain while in the cystic duct, passing readily along the common duct. The colic will, therefore, be of short duration, and there will be no jaundice. Medium-sized stones—a pea to a cherry—may cause great distress. They may enter the cystic duct and fall back again into the gall bladder. One stone may, therefore, cause several attacks of colic. They may engage the common duct and produce severe jaundice. Large stones cannot pass the duct. They induce no regular colic, but may be attended by a sense of weight and uneasiness about the gall bladder. Gall stones may be discovered *post mortem* in patients who have never had any symptoms of gall stones during life.

Effects produced by gall stones.—A gall stone lodged in a duct may cause ulceration. This may lead to perforation of the duct and peritonitis. Large or medium-sized stones may pass directly by means of ulceration into the duodenum or transverse colon. The fistulous tract thus made is shut off by peritoneal adhesions. The passage of the stone is usually attended with symptoms of localised peritonitis. In this way large stones have entered the bowel. Such stones may lodge in the bowel and produce the symptoms of intestinal obstruction.

If the cystic duct be blocked, the outflow of mucus from the gall bladder is stopped. The gall bladder becomes distended with altered mucus, and may attain in due course very considerable dimensions. This is called *dropsy of the gall bladder*. There will be no jaundice in obstruction of the cystic duct. The distended gall bladder enlarges in a direction downwards and forwards. It often follows a line which will start from the tip of the ninth costal cartilage, and will cross the median line some little way below the umbilicus.

When the gall bladder is much distended, it forms a tumour in the line indicated. This swelling is smooth and rounded, and usually well defined (Fig. 772). It is elastic and possibly fluctuates. It is evidently connected with the liver, and moves with that organ in respiration. A distended gall bladder has been mistaken for hydatid cyst and cancer of the liver, for cancer of the omentum, and for renal and ovarian tumours.

If there be no jaundice, the block must be in the cystic duct.

If the common duct be obstructed, the bile cannot escape into the bowel. Jaundice at once follows. If the obstruction be complete, the gall bladder becomes distended, the liver enlarged, and the jaundice intense. Chronic obstruction of the common duct is often due to cancer. In distinguishing the obstruction due to cancer from that due to gall stones, Osler lays stress upon the following features as characteristic of the latter condition: (1) jaundice of varying intensity deepening after each paroxysm, and persisting for months or even years; (2) ague-like paroxysms, after which the jaundice usually becomes more intense; (3) pain in the hepatic and epigastric regions during these paroxysms.



Fig. 772.—Case of distended Gall Bladder. The dilated organ forms a cylindrical tumour reaching to the umbilicus.

The greatly distended gall bladder may become thinned and give way, causing fatal peritonitis. It may inflame and become filled with mucus—*empyema of the gall bladder*. This collection of matter may burst into the liver, into the stomach or bowel, or discharge through the skin at any point along the line, followed by the enlarging gall bladder. Such abscesses not infrequently open near the umbilicus. Some have discharged themselves near the left groin. (For Biliary fistula see page 595.)

Treatment.—Medical methods of treatment need not be here considered. The cases calling for surgical treatment are thus arranged by Mr. Robson: (1) cases marked by repeated attacks of gall-stone colic, which resist all

treatment and are exhausting the patient's strength; (2) when there is evidence of suppuration about the gall bladder, due to gall stones; (3) in empyema; (4) in dropsy of the gall bladder; and (5) in obstructive jaundice, due to gall stones in the common duct.

The operations available are the following: cholecystotomy; cholecystectomy; cholecystenterostomy. There is nothing to be said in favour of exploratory punctures with needles, nor of aspirating the distended gall bladder. These measures are attended by no little risk.

Cholecystotomy.—The operation of cutting into the gall bladder. The incision is made over the most prominent part of the tumour—when a tumour exists. When there is no distinct distension of the gall bladder, a vertical cut is made in the right semilunar line, starting from the costal margin. The gall bladder

is brought to the parietal wound—a matter often attended with very considerable difficulty. Extravasation of bile is limited by a packing of sponges. The gall bladder is opened. Loose stones, pus, or mucus, are removed. Stones lodged in the ducts may be removed in many ways—some, especially those in the cystic duct, may be extracted by forceps or a scoop. Others may be broken up by forceps introduced through the opening in the gall bladder. In another class of case—and this more especially concerns the common duct—the duct is cut open, the stone is removed, and the duct is closed again; or, without venturing upon the additional risk of such an incision, the stone is broken up *in situ* by the thumb and finger, or by a needle introduced through the duct wall, or is crushed by padded forceps applied outside the duct wall. These various measures of crushing the stone are known as *cholelithotrixy*. In some cases in which it is impossible or inexpedient to open the gall bladder, this procedure constitutes the sole feature of the operation. After the stones have been removed, the margins of the gap in the gall bladder are united to the edges of the parietal wound, and a biliary fistula is established. If the duct be clear, this fistula will close spontaneously in the course of a few weeks.

This operation is very successful. The mortality is estimated at about 6 per cent. In the hands of some surgeons it has been much less than this. If jaundice be present, the risk of the operation is increased.

Cholecystectomy.—In this operation the gall bladder is removed. Mr. Robson gives the following as the indications for this procedure: (1) Where, after cholecystotomy, the gall bladder is contracted and cannot be sutured to the parietes, and it is assumed that the common duct is clear. (2) Where suppurative changes in the wall of the gall bladder have rendered suture impossible. (3) Where there is complete obliteration of the cystic duct.

The operation is performed through the same incision as for cholecystotomy. The gall bladder is readily stripped away from the liver. The cystic duct is isolated and ligatured, and the gall bladder cut away. The mortality would appear to be about 10 per cent.

Cholecystenterostomy.—In this procedure a permanent fistula is established between the gall bladder and the bowel. It is indicated in incurable biliary fistula, in permanent obstruction of the common bile duct, and also in cases of jaundice due to insuperable occlusion of the common duct.

The abdomen is opened in the right semilunar line, and the gall bladder is exposed. The nearest loop of the upper jejunum is now brought up and is fixed to the gall bladder by a row of sutures arranged in a circle, and enclosing an area, if possible, equal to the lumen of the bowel. The gall bladder is now opened and emptied, and through this opening a communication is made between the gall bladder and the bowel, within the area embraced by the suture line. If necessary a few additional sutures are inserted. The

operation is completed by closing the wound made in the gall bladder where it was opened and the wound in the parietes. The operation may be divided into stages. In the first stage the unopened bowel is fixed to the unopened gall bladder by sutures. In the second stage the gall bladder is incised, and the communication with the intestine is made by means of a knife introduced through that incision. In the third stage this incision in the gall bladder is closed. This operation has been performed so far at least seven times with one death.

Among the many mechanical appliances which are used in intestinal surgery is "Murphy's Button." It has been employed with great success in this particular operation, and has rendered the procedure comparatively simple.

AFFECTIONS OF THE SPLEEN.

Abscess and tumours of the spleen.—Metastatic abscesses and growths are often met with in the spleen. They call for no surgical treatment. Primary abscesses may result from injury, and especially with fractured rib. In many cases of supposed splenic abscess the pus is in reality outside the spleen, and is due to localised suppurative peritonitis. These abscesses may burst into the pleura, into the general peritoneal cavity, or into the colon. Primary sarcoma has found a place in this organ. Angeiomata also occur and certain cysts of doubtful origin. Some of these appear to arise from degenerative changes in angeiomata, and others to result from necrotic processes in the pulp of the organ. Hydatid cysts are met with; but compared with other abdominal organs, the spleen is very rarely the seat of this affection.

The spleen may become greatly enlarged in leucocythæmia and as a result of certain fevers, and especially in association with malaria. (For the characters of splenic tumours *see* page 663.)

Splenic cysts and abscesses have been incised and drained with success.

Movable spleen.—This condition would appear to be due to the same conditions as lead to movable kidney. It is rare. It is assumed to result from yielding and stretching, or possibly from tearing, of the peritoneal folds and ligaments which support the organ. It is met with only in adults, and most commonly in women who have borne many children. The spleen may be so displaced downwards as to reach the iliac fossa. It gives rise to uneasiness, sense of weight, dragging and oppression in the abdomen, pain in the back, colic, and digestive disturbances. The splenic vessels may be dragged upon and the organ may become twisted, acute symptoms being produced akin to those of acute peritonitis. As a result of such torsion, fatal peritonitis may ensue, or the spleen may become in due course atrophied.

Splenectomy.—This operation concerns itself in the removal of the spleen. In some cases of injury, and in a few examples of

tumour, a portion only of the organ has been removed. In most instances the whole spleen has been taken away.

The most convenient incision is in the left semilunar line. In many instances the abdomen has been opened in the median line. When adhesions—if any—have been dealt with, the organ is gently brought out through the wound. The greatest care must be taken of the pedicle, which is composed of large and ill-supported vessels. There should be no traction upon it. If it can be secured by a temporary clamp, it is well. In some cases a temporary ligature suffices. The vessels should, if possible, be secured separately. The pedicle should be slack when the ligatures are tied, and should be held by pressure-forceps on the proximal side of the intended cut which severs it. This will allow of the divided surface being kept in view should any of the ligatures slip. Death from hæmorrhage constitutes the great risk of the operation.

The following list of cases from Fussell's collection of recorded examples will give some idea of the risk of the operation: 99 cases of splenectomy; 28 for simple hypertrophy, with 19 deaths; 24 for leucocythæmia, with 23 deaths; 26 for injury, with 1 death; 16 operations for movable spleen, with 1 death; 5 for cysts, with 1 death. König gives 9 cases of splenectomy for hydatid cyst, with 1 death; and notes two successful examples of the operation for lympho-sarcoma.

A perusal of the above list of cases makes it needless to say that the operation should never be performed in leucocythæmia. Practically all the patients have died of hæmorrhage or shock.

After splenectomy there is generally noticed a relative increase in the number of the white blood corpuscles, and a diminution in the amount of hæmoglobin. Patients often exhibit a condition of defective nutrition which is comparable to that met with in myxœdema. If the after-history of the cases of splenectomy be inquired into, it will probably be made evident that—in its ultimate results—the operation is not so successful as has been assumed.

AFFECTIONS OF THE PANCREAS.

Inflammation and abscess.—The pancreas may be the seat of acute inflammation, and this may run on to the production of abscess or of gangrene. In certain of the acute cases there have been symptoms of deep-seated intra-abdominal inflammation, and death has followed in from three to four weeks. Some of such cases might possibly have been treated with success by operation.

In association with inflammation of the pancreas there may be considerable hæmorrhage. This may extend far beyond the limits of the organ and form a huge mass of clot at the posterior part of the abdomen, occupying the root of the mesentery and of the meso-colon, and possibly the cavity of the omentum. These cases of hæmorrhage, when acute, are marked by sudden and violent pain in the epigastrium, which spreads over the abdomen. The belly wall becomes

board-like and tender. There are vomiting and constipation, hurried breathing, and perhaps delirium. Death occurs in two to four days. It will be observed that the symptoms resemble those of acute peritonitis.

Cysts.—There is some obscurity about the origin of pancreatic cysts. They appear to be retention cysts depending upon the closure of some of the smaller ducts. Closure of the main duct, on the other hand, leads to atrophy of the pancreas. In some of the cases there is a history of injury. In others there would appear to have been antecedent hæmorrhages.

Cysts occur mostly in the tail of the organ, are more common in males and are met with at all ages.



Fig. 773.—Pancreatic Cyst in a Man aged 50.

The tumours formed vary greatly in size, and may attain such enormous proportions as to fill nearly the whole of the abdomen. The cyst is unilocular. The contained fluid has a sp. gr. of 1010 to 1020, is usually turbid, and of a greenish or brownish colour. It is alkaline, contains some albumen, and has the power of emulsifying fat. In a few cases the fluid has been clear.

The **symptoms** vary. There is usually neuralgic pain about the coeliac axis with exacerbations. Complaint is made of great fulness within the abdomen, there is dyspepsia, with constipation and occasionally with jaundice. Fatty stools do not appear to be met with. There are wasting and great depression, and sometimes a pigmentation of the skin ("earthy skin"). The

tumour is smooth, round, and elastic. Fluctuation is very seldom to be obtained. The stomach is pushed forwards and to the right and the transverse colon is displaced downwards.

The tumour is deep-seated, may move on inspiration, and, as a rule, grows rapidly. It has been only rarely diagnosed, and has been mistaken for ovarian cyst, mesenteric cyst, hydronephrosis, and encysted peritonitis (Fig. 773). In one case in which I operated, and in which the abdomen had become rapidly filled with what appeared to be a soft growth, the diagnosis of lymphosarcoma had been made.

Treatment consists in free incision and very free drainage. The operation may be carried out in two stages. (See page 582.) The discharge acts upon the skin, which must be protected with boric acid ointment. Some thirty operations have been recorded, and they have been attended with excellent results, the mortality being

about 6 per cent. In a few instances the cyst has been dissected out in whole or in part, but that measure has been attended with most unsatisfactory results, and is to be condemned.

Cancer is met with in the pancreas mostly as a secondary condition. As a primary growth it is more common in males than in females. A malignant growth of the pancreas has been removed by operation. The operation is not, however, likely to be often repeated.

AFFECTIONS OF THE MESENTERY AND OMENTUM.

Mesenteric cysts.—Various cysts are met with in the mesentery. The precise pathology of these tumours is not yet forthcoming. So far as our knowledge at present extends they may be divided into (1) hydatid cysts, (2) lymph or chylous cysts, (3) blood cysts, and (4) dermoid cysts. The hydatid cyst calls for no special comment. The lymph or chylous cyst takes its origin in the lymphatic vessels or glands of the part. These cysts may attain considerable size, and one has been described as large as an adult head. They possess a distinct wall, which is said, however, to present an endothelial lining. They contain either serous fluid like lymph in most particulars, or a white, opaque chylous fluid, which may be thick, and contain much cholesterin. Of cysts containing blood little is known. They are assumed to be due to the giving way of a blood-vessel between the layers of the membrane or to hæmorrhage into an existing cyst.

At least one case of dermoid cyst has been met with and treated by operation.

Speaking generally, mesenteric cysts—which are very rare—are attended by few symptoms. The tumour produced is generally discovered near to the middle line, is very movable, and usually painless. In more than one instance a mesenteric cyst has been mistaken for an ovarian tumour.

Treatment.—Some nineteen cases of laparotomy for mesenteric cyst have been recorded. In one instance the cyst was dermoid, in six chylous, in four it is described as a lymph cyst, and in eight as a serous cyst. In some few instances the cyst was excised, but in the great majority of the instances it was drained. The latter procedure appears up to the present to be by far the safer. Of the nineteen patients, seven died and twelve recovered.

Tuberculous glands in the mesentery.—These glands, which are commonly dependent upon tuberculous mischief in the intestine, may attain great size. They may continue to enlarge long after all signs of definite trouble in the bowel have passed away. The glands so placed may become caseous and may suppurate. They are met with both in children and in adults. I have operated upon a case in a child in which I found only one gland, and that was the size of a goose's egg. In another instance I met with some ten very large glands, all of which were caseous, while some contained pus. In

this instance a very remarkable movable nodulated tumour was produced, which was tender but not painful. The patient, a woman of twenty-five, had at the time no known tuberculous disease elsewhere. At first the nodular tumour was supposed to be due to a faecal accumulation. In another case the glands removed were wholly calcareous.

In many instances these tuberculous glands have been dealt with by operation. They may be shelled out, or if very adherent, may be opened and scraped and filled with an iodoform gauze plug which acts as a drain. If the glands are numerous or extensive, nothing can be done. I have noticed that a simple exploratory incision has in some cases been followed by subsidence of the glands.

Mesenteric and retro-peritoneal lipomata.—A pure lipoma or a myxolipoma often appears to start from the side of the vertebral column and make its way into the retro-peritoneal tissue in the vicinity. The tumour may grow between the layers of the mesentery and produce a mesenteric tumour of varying size. It may—with or without invading the mesentery—extend in the retro-peritoneal tissue about the posterior wall of the abdomen, and enter the layers of the mesocolon when such fold exists. Indeed, wherever sub-peritoneal tissue exists there the growth may penetrate. I have, for example, removed one of very considerable size from between the layers of the broad ligament.

These retro-peritoneal lipomata may attain to enormous dimensions, and tumours weighing 35 lbs. and 57 lbs. have been recorded. They cause trouble only by their pressure effects, which are, however, not marked.

The belly is found to be more or less occupied by an indefinite tumour, which appears to have its starting-point from the depths of the cavity and to push the hollow viscera before it. An obscure sense of fluctuation is often noticed, and these large growths have been mistaken for ovarian and other cysts and for sarcomata. The individuals in whom they are met with are not usually corpulent, and may, indeed, be spare and thin.

This form of abdominal tumour does not appear to have been diagnosed before operation or death.

Some ten operations for the removal of these lipomata have been carried out, but with only three recoveries.

The removal of these great masses is attended with considerable difficulty and danger, and it has not been shown that they cause the patient other than inconvenience if left. If, therefore, a retro-peritoneal lipoma be revealed by an exploratory incision it should only be removed when it is evident that the operation will be quite simple. Recorded cases appear distinctly to show that more evil may be wrought by the operation than by the undisturbed growth.

Retro-peritoneal sarcomata.—These growths are not uncommon. I have met with them in patients of all ages, but mostly in those who have passed middle life, and in men. The symptoms are most insidious. There is an indefinite swelling in the abdomen,

attended by vague and often insignificant local symptoms, but associated with loss of strength, loss of colour, and loss of weight. The tumour pushes the viscera—and notably the colon—before it. The mass is usually lobulated, fixed, elastic, and not well defined. The growth may attain great size. Ascites is usual in the later stages. The commonest seat is one or other loin, behind the colon. No operative treatment is possible, but I have seen the mass cease to grow for a time after a simple exploratory incision.

Tumours of the omentum.—Hydatid cysts are met with in the omentum. But with this exception cysts are rare in this part. A few simple, non-parasitic cysts have been observed, and some of these have been successfully treated by operation. The origin of these cysts is obscure. Some are supposed to have been due to hæmorrhage following a blow. One large cyst removed from the omentum was filled with cholesterin. Omental cysts are best treated by excision, care being taken to secure the numerous vessels which will probably be divided. Should they prove to be of great size or to have contracted many adhesions, it is better that they should be incised and drained.

An ovarian cyst has become twisted upon its pedicle and has finally become entirely detached from its pelvic connections. In the meanwhile adhesions from the omentum have surrounded the tumour, and from the vessels in these adhesions the cyst has been nourished. In such cases a cyst—having the character of an ovarian tumour—has been found apparently growing from the omentum. Certain large “dermoid cysts of the omentum” are no doubt of this origin.

Malignant disease is not uncommon in the omentum. It is very usually secondary.

Primary carcinoma is unknown in the omentum, as it is in other parts of the peritoneum, there being in that membrane no epithelium from which the growth could take origin.

Sarcoma may occur in the omentum as a primary growth, and is by no means uncommon. It is met with mostly in adults under forty-five. The onset is insidious, the most conspicuous features being a steadily increasing weakness and lack of energy, a gradual but most definite wasting, an enlargement of the belly, and certain digestive disturbances. These take the form of want of appetite, flatulency, occasional colic, occasional nausea or vomiting, and, as a rule, constipation. A tumour is soon discovered, usually in the vicinity of the umbilicus. It is hard, movable, and painless. It is commonly at first mistaken for a fæcal mass—and such masses may exist elsewhere in the abdomen—or for a malignant growth about the pylorus. Ascites appear early. The tumour extends rapidly. The anterior surface is always flat—a very important sign—it commonly has a distinct sharply cut and hard margin. It is often dull on very light percussion and resonant on heavy percussion. It often feels like a cake moulded to the anterior belly-wall and floating about in the abdominal cavity.

The lump often “tumbles about” in the belly, and the patient is

conscious of its movement. It can be best examined when the patient is on the hands and knees. The progress of the growth is rapid, and death occurs usually from exhaustion.

I have exposed these growths in exploratory incisions, but in no case did it appear possible that the mass could be removed with any prospect of ultimate success.

Several of these sarcomata—some of very large size—have been removed by operation, but with discouraging results.

ABDOMINAL ABSCESES.

No detailed description of the numerous forms of abscess met with in and about the abdominal cavity is called for. It will be sufficient if the chief varieties are enumerated.

Abscess in the abdominal parietes may follow upon injury, upon rupture of muscle, hæmorrhage, and wound.

Tuberculous abscesses are also met with in this situation.

Collections of pus within the abdomen may extend through the parietes, and may burrow extensively between the layers of muscles. This is often seen in connection with pelvic peritonitis (pelvic "cellulitis").

All collections of pus in the abdominal parietes are apt to burrow, and call for speedy incision and efficient drainage. As it is difficult or impossible to keep the abdominal wall at rest, it follows that these abscesses are apt to lead to sinuses which are slow in closing. All such sinuses should be freely opened up and dealt with without delay.

Ventral hernia may follow upon an extensive abscess in the abdominal wall. This complication affords another argument in favour of prompt treatment and of insisting upon absolute rest in the recumbent position until the suppurating cavity or tract is closed.

In cases in which the abscess has reached the parietes from some primary focus within, the persistence of the resulting sinuses may depend upon the persistence of the original trouble within the abdomen. Until this is treated the surface disturbances are likely to continue.

Abscesses of viscera.—The principal of these are abscess of the liver (page 579), of the spleen (page 586), of the pancreas (page 587), of the gall bladder (page 584), and of the kidney. (See Article LI.) They are considered in the places indicated. In the present category may be placed abscess due to suppuration set up in existing cysts, as, for example, in ovarian cysts, and in hydatid tumours. These call for no special notice. To the phenomena of the cystic tumour are added the phenomena of deep-seated inflammation, which will exhibit themselves in varying intensity and degree.

The treatment is summed up as follows:—a free and early incision with suitable precautions; free drainage; surgical cleanliness; rest.

Peritoneal abscess.—In any form of suppurative peritonitis

the pus produced may be more or less distinctly localised or encapsuled, and thus a more or less defined abscess may be made evident.

The two more common forms depend upon perityphlitis (page 626) and tuberculous peritonitis (page 619). It is only necessary to add that whatever may induce localised peritonitis may induce a peritoneal abscess, and so such collections are met with in connection with puerperal and pelvic peritonitis, with perforative lesions in the stomach and intestines, with cancer of those parts, with certain affections of the urinary bladder, and in association with the various visceral abscesses, to which allusion has been already made.

Retro-peritoneal abscess.—Pus, when it reaches any part of the very extensive area occupied by the loose retro-peritoneal tissue, finds itself in a district in which spreading and burrowing are much favoured, and in which a large collection of pus may readily develop. The elaborate classifications of these retro-peritoneal abscesses are artificial and useless.

The surgeon has but to realise the position, extent, and arrangement of the retro-peritoneal tissue, and to acquaint himself with the sources from whence pus may enter that tissue.

The more immediate details of the abscess are influenced by the laxity and extent of the tissue invaded, by the laws of gravity and by the circumstances which tend to limit or favour the spread of suppuration generally.

Suppuration in the retro-peritoneal tissue may be due to purulent mischief in the pelvis, to certain bladder troubles, to perforative affections of the colon or duodenum, to suppuration in the lymphatic glands, to disease of the ribs, pelvis, or spine, to extension from an empyema in the pleural cavity, to abscess of the pancreas, to suppurative inflammation of the kidney, and to other causes which will be more or less obvious, and which need not be detailed.

A primary tuberculous abscess may form in the retro-peritoneal tissue. Such collections are not uncommon in the lumbar and iliac regions, and in many instances are quite independent of any tuberculous disease in the vicinity. They may, indeed, be the only existing evidence of tuberculosis. The treatment of such abscess is given—in general terms—on p. 98, Vol. I.

The lax and extensive tissue around the kidney is very favourable for the spread of suppuration, and an abscess invading this tissue is termed *perinephritic*.

In the great majority of cases these abscesses are due to suppurative inflammation of the kidney, such as may follow upon calculus, tubercle, or the effects of a narrowing in the urinary passage. It may, however, be due to disease in the colon, duodenum, or pancreas, or even to caries or necrosis of one of the neighbouring bones. Primary tuberculous abscess has been met with in this tissue.

The abscess, when of fair size, makes itself evident by a swelling, which has most of the characteristics of a renal tumour, but which is fixed, is ill-defined, and shows a great tendency to bulge into the

loin. There are usually the general symptoms of inflammation. The skin over the loin may be œdematous. The side is stiff, certain spinal movements are limited, and the column may be so rigid as to suggest spinal disease. There may be pain in the thigh or bladder, some difficulty in moving the thigh, and in a few instances œdema of the foot. The treatment consists, it is needless to say, of a speedy and free incision, the removal, if possible, of the cause of the supuration, free drainage, surgical cleanliness, and rest.

ABDOMINAL FISTULÆ.

Under this heading will be considered—(1) gastric, (2) biliary, and (3) fecal fistulæ.

1. **Gastric fistula.**—This form of fistula is rare. A communication leads through an opening in the skin into the cavity of the stomach. As a rule, the anterior wall of the stomach is closely attached by numerous adhesions to the anterior abdominal parietes, at the site of the fistula.

The condition has followed upon gunshot wounds, as in the well-known case of Alexis St. Martin, upon contused wounds, and upon perforating ulcers of the stomach. These last must have penetrated the wall of the viscus slowly and allowed adhesions to form. Sometimes the communication between the opening in the skin and that in the stomach has been through an abscess cavity. Dr. Murchison reported the case of a hysterical woman, in whom a gastric fistula was produced by the continued pressure of a copper coin worn over the epigastric region. The coin was deliberately applied in order to excite a lesion. Sharp foreign bodies lodged in the stomach have led to gastric fistula, but the occurrence is rare. The commonest gastric fistula is that intentionally produced in the operation of gastrotomy. (See also page 576.)

The *symptoms* vary greatly, and depend mainly upon the size of the sinus, and its position with reference to the stomach wall. More or less of the gastric contents escape. The skin becomes much irritated, and is usually eczematous or ulcerated. The margin of the sinus is apt to be greatly indurated in chronic cases. The patient wastes, and is very often the subject of intense gastric irritation, or of actual acute gastritis. There is usually, even in the least troublesome cases, a gnawing pain in the stomach; nausea or vomiting, and thirst are complained of. There is a feeling of hunger, and constipation is usual. Patients may live for years with a gastric fistula, but if unrelieved they usually die of exhaustion following upon malnutrition, constant gastritis, and the continued local worry of the fistula.

The *treatment* consists in limiting the diet to the simplest of foods, and to taking care that the fistula and the parts around are kept as nearly as possible surgically clean. The acute gastritis in these cases is no doubt usually a septic process. The skin should be

kept as dry as possible by constant changing of absorbent pads, and is protected from the irritation of the gastric juice by an ointment of vaseline or lanoline and bicarbonate of soda. Powdered bicarbonate of soda is also used in the absorbent pads.

Sometimes the escape of fluid from the fistula may be prevented by the pressure of a pad, but it is not often that this can be borne. The pressure may cause more irritation to the skin, and may even enlarge the opening.

The smallest fistulæ may close after repeated applications of the actual cautery, but the large ones will need to be closed by a plastic operation.

This has been carried out successfully without opening the peritoneal cavity, the walls of the abnormal orifice having been freshened *in situ* and then brought together by several rows of buried sutures. Very usually the abdomen will have to be opened, the tissues around the hole in the stomach cut away, and the gap thus produced in the viscus closed by a double row of sutures as in dealing with a wound. The operation is rendered uncertain by the fact that the peritoneum around the opening is probably occupied by dense and extensive adhesions, and then a precise closure in the serous coat of the stomach is scarcely possible.

2. Biliary fistula.—In this variety there is a communication between the biliary passages—as a rule, the gall bladder—and the surface of the skin.

Biliary fistulæ in the great majority of instances depend upon gall stones (page 583).

In some few instances they have followed upon gunshot and other wounds, involving the gall bladder or bile ducts. The amount of discharge varies greatly. In simple cases in which the sinus is small there may be only a trifling escape of bile-stained mucus daily. In instances in which the common bile duct is blocked, all the bile produced is discharged through the fistula. Indeed, the chief element in the prognosis in these conditions is the state of the main biliary duct.

The cases of fistula which have resulted from wound of the gall bladder, and in which the bile ducts were patent, have generally closed spontaneously. In the treatment of this variety it is only necessary to keep the patient at rest, to keep the part very clean, to maintain some degree of local pressure, and to protect the skin with some greasy substance.

Cases in which one or other of the bile ducts have been accidentally divided have also done well, and have closed spontaneously, there being no obstruction in the passage. If there be an obstruction, then the fistula is more or less certainly persistent. If the common duct be blocked, then the whole of the bile will come through the fistula. It has been shown that when this condition exists the patient does not of necessity waste, nor does the digestion become impaired if the fatty elements in the food be reduced, but the annoyance caused by the fistula is intolerable. In a case of

complete fistula as much as thirty ounces of bile may escape from the sinus in twenty-four hours.

Persisting fistulæ, associated with obstruction in the biliary passages, must be dealt with by one or other of the measures mentioned in the account of affections of the gall bladder (page 585).

In one very admirably reported case by Mr. Mayo Robson, a complete fistula was practically "cured" by cholecystenterostomy, the flow of bile being once more returned to the intestine.

3. Fæcal fistula. *Varieties.*—In this form of fistula there is communication between the lumen of some part of the bowel and the surface of the skin. Through the abnormal channel and openings thus existing more or less of the contents of the bowel may escape. If the communication with the bowel be through a small orifice, the term *fæcal fistula* is commonly used, but if the opening be very large,

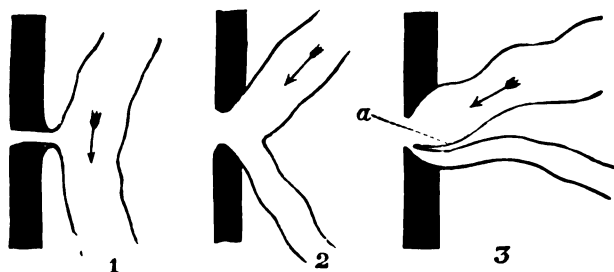


Fig. 774.—Forms of Fæcal Fistula: a, the éperon. (From Treves's "Operative Surgery.")

so that the whole of the greater part of the intestinal contents is discharged upon the surface of the skin, then the term *artificial anus* is usually employed. The fistula is met with under many conditions.

(a) The bowel may be closely adherent to the parietes, and a probe passed through the opening in the skin will pass directly into the gut. Indeed, when the opening is large enough the mucous membrane protrudes, and often stands out beyond the level of the skin as a prolapsed part.

(b) The bowel in which the fistulous opening exists may be situated at some distance from the skin opening. This latter aperture may be near the umbilicus, while the bowel involved is fixed deeply in the pelvis. In such case a sinuous and often irregular channel connects the internal and the external apertures, or the communication between the bowel and the cutaneous sinus may take place through an abscess cavity or even through a cyst; as, for example, when a dermoid cyst of the ovary has suppurated and has discharged into the bowel in one direction and through the skin in another.

(c) In the majority of cases of fæcal fistula there is only one

external opening. There may, however, be many openings in the skin, all discharging intestinal matter. In such instances the various openings are connected by subcutaneous or subperitoneal passages which may have been produced by the burrowing of pus.

(*d*) When the hole in the bowel is small there is seldom much deflection of the gut at the point of the fistula (Fig. 774, 1). When, however, there is a large opening in the bowel, when the whole or the greater part of the circumference of the gut has been destroyed at the involved spot, and when the bowel in question is provided with a mesentery or meso-colon, there is generally an abrupt bending of the intestinal tube at the site of the artificial anus (Fig. 774, 2). The bend may be so acute that the opposed walls of the gut on the side opposite to the opening in the skin form a kind of diaphragm transverse to the long axis of the bowel. This diaphragm is the *éperon* or spur (Fig. 774, *a*). It serves, when well marked, almost completely to cover over the orifice of the lower segment of the bowel and so to cause all the intestinal contents to be discharged on the surface of the skin. When it is less marked it gives to the opening into the bowel—when seen from the skin—the appearance of the muzzle of a double-barrelled gun.

(*e*) Some fæcal fistulæ are congenital, such, for example, as are met with at the umbilicus in the case of a persistent vitello-intestinal duct (page 601), or in the vagina and bladder in instances of congenital malformation of the rectum (page 743).

(*f*) As a result of disease a fistulous communication may be formed between one part of the intestinal canal and another as, for example, between the ileum and the rectum. A fistula due to like causes may connect the bowel and the bladder. This variety is dealt with at the end of the present section (page 599). The fistulæ which may connect the rectum and vagina, etc., and which result mainly from damage received during parturition, are not considered in this place.

The *causes* of fæcal fistula are very numerous. In some instances, as already noticed, they are congenital. Many fistulæ are due to injury, to stabs, to gunshot wounds, and to surgical operations. Not a few follow ulcerative processes in the bowel, as seen in some rare cases of typhoid fever, and of impacted foreign bodies (*see* Fig. 782), in many cases of cancer of the bowel, and very often as a final result of perityphlitis. Tuberculous ulceration of the bowel and tuberculous peritonitis are also common causes of fæcal fistula. Almost any intra-peritoneal abscess may open into the bowel in one direction and through the skin in another.

Many instances of fæcal fistula depend upon gangrene of the bowel after strangulated hernia.

The *symptoms* will obviously depend mainly upon the size of the opening and its position in the bowel. A very small fæcal fistula in any part of the intestine may exist for years without causing the patient any real harm. A large fæcal fistula in the upper part of the small intestine soon leads to death from marasmus.

A like opening into the ileum will, sooner or later, lead to the same result. An artificial anus in the colon, especially in the lower part of it, may exist for years and cause no disturbance to the general health. When the false anus is high up in the bowel the discharge is fluid, is irritating, and is escaping almost constantly. The skin becomes sore and raw, and even ulcerated, and the distress to the patient is very considerable. When the sinus is lower down in the colon the discharge is solid or semi-solid, is not markedly irritating to the skin, and is discharged at intervals. With reasonable attention an artificial anus in the colon may give but little trouble. An artificial anus in the colon is very apt to be associated with prolapse of the mucous membrane. The part prolapsed may be several inches, or even a foot in length, and may occasion considerable distress. In the more marked cases the prolapsed mucous membrane has to be removed.

The constant escape of flatus from a fæcal fistula is a cause of great distress to the patient, and this is apt to be more troublesome in the colic than in the enteric fistulæ.

Treatment.—Fæcal fistulæ dependent upon cancer of the bowel call for no special treatment. Fistulæ due to tuberculous peritonitis had better be treated by expectant measures. The sinus is often found to be of great length and very tortuous, and there may be two or more openings into the bowel. Attempts to close these fistulæ by operation have (especially in the case of young children) met with the most discouraging results.

Many small fæcal fistulæ due to injury heal spontaneously in the course of time. The same may be said of fistulæ following abscess around the cæcum, and due to a perforation in the appendix or in the caput coli. These fistulæ are exceedingly difficult to close by operation, especially when the cæcum is involved. In many cases all operative measures have failed, and not a few lives have been lost. The removal of the partly-destroyed appendix will lead to the healing of some. On the other hand, these sinuses show a disposition to spontaneous healing, and may close after months, or perhaps years, and after many relapses.

The general treatment of fæcal fistula may be illustrated by a case due to strangulated hernia, in which the opening is in the ileum.

The diet should be as simple as possible, and should be of such a kind as to leave little *débris* in the bowel. The digestion should be attended to. Intestinal antiseptics should be used; the most efficacious of these is salol, gr. x, in powder, twice a day.

A very irritating discharge will often become comparatively bland under the influence of salol.

It will be found also that the matter escaping from the fistula varies in its irritating properties from time to time, and is influenced by diet and the general state of the health.

Much can be done to keep the skin from being unduly inflamed by frequent dressing, by keeping the parts as dry as possible, and

by protecting the skin with a covering of boric acid ointment, or of lanoline and hazeline. Patients and nurses often manufacture ingenious aprons for the sinus out of guttapercha tissue. They afford some protection.

Scrupulous cleanliness is, indeed, the great element in securing any degree of comfort to the patient.

Now and then a fæcal sinus, resulting from strangulated hernia, closes spontaneously, more particularly in the femoral region. The larger openings must be closed by operation. The main bar to the closing of the sinus is the diaphragm or *éperon*.

In a few instances this fold, when alight, has been caused to disappear by introducing a rubber tube (properly secured) into the ends of the bowel. The tube tending always to become straight, in time may overcome the bend or kink in the bowel. Following this simple measure, two courses are open :

(1) The use of an enterotome. The instrument usually employed is a modification of that invented by Dupuytren. A blade is introduced into each end of the bowel, and the two blades are then screwed together, crushing the *éperon* between them. When, in the course of time, the instrument becomes detached there is found—in the successful cases—a large and direct passage between the two ends of the bowel. The skin opening may now be closed by a plastic operation, or may be left to heal up spontaneously.

(2) The resection of the involved part of the bowel. The two ends are isolated, as much as is necessary is removed from each end, and the freshened surfaces are united by a double row of sutures. Some surgeons employ bone or rubber plates, buttons, or bobbins for this operation.

It must not be supposed that all cases of fæcal fistula needing operation call for so extensive a measure as that just detailed. Resection is needed for the extreme cases where the aperture is large, or the loss of bowel wall great. In the smaller fistule it is sometimes possible to excise all the parts immediately concerned in the fistula. An elliptical piece is removed from the bowel, and the gap so produced is closed by a double row of sutures. The freshened edges of the gap in the skin are then brought together.

A comparison of Dupuytren's operation by means of the enterotome with the operation of resection of the gut for fæcal fistula gives the following results :—

Eighty-four cases of Dupuytren's operation have been collected. The mortality was 8·5 per cent. ; the cure was complete in fifty cases. Of the remainder there was improvement in twenty-six.

Makins has collected thirty-nine cases of enterectomy for artificial anus. The mortality was 38·4 per cent. Three of those who recovered were not improved. In spite of these figures the latter operation will no doubt be the operation of the future. The mortality of resection operations for fistula is declining : and as methods are more perfected, there will no doubt be a substantial improvement upon the above results.

Vesico-intestinal fistulæ.—In these cases there is a communication between the bladder and some part of the bowel, so that flatus and fæces are passed by the urethra. Mr. Harrison Cripps has collected sixty-three examples of this trouble. In twenty-five of the cases the fistula was in the rectum, in fifteen in the colon, in twelve in the small intestine, in five in the colon and small intestine, and in six cases its position in the gut was not ascertained.

The *causes* of the fistula in the sixty-three cases are thus arranged: in two instances there was an injury involving both bladder and rectum; in nine cases the communication was due to cancer; in forty-five instances—i.e. in over 70 per cent.—the fistula was due to abscess or simple ulceration. Many of these abscesses were due to localised forms of peritonitis. In the remaining seven cases out of the sixty-three the cause of the trouble was not discovered. The affection is twice as common in men as in women, and the majority of the patients have been over fifty years of age. The youngest patient was twenty-seven, the oldest seventy-nine.

The *symptoms* may begin with a history of bowel disorder or of peritonitis, or of abscess deep down in the pelvic region. In some instances escape of flatus is the first evidence of the disease. The flatus usually escapes with the urine, often with a great rush. When fæcal matter begins to enter the bladder, the patient's severest troubles commence. There may be most agonising pain and a distressing degree of cystitis. The urethra may be blocked with fæcal matter. In the cases of cancer there is hæmorrhage from the bladder, and in some instances I have seen this has been alarming in amount. Now and then a case is met with in which the patient suffers comparatively little distress from the fistula, which will often close for a while and open again.

It is strange that in these cases of vesico-intestinal fistula, urine is very seldom passed by the bowel, or at least in the great majority of the instances that symptom has not been noticed. In the female subject the urethra can be dilated and the fistula inspected.

The prognosis is very bad. In the majority of the collected cases the patient lived only a year or two after the appearance of the fistula. Some died in a few months. The symptoms are less severe and the prognosis less bad in women as compared with men.

The *treatment* consists in allaying pain by morphia, in keeping the bowels acting, in insisting on a diet which will leave as little débris as possible in the bowel, and in frequently washing out the bladder. Beyond this there is little to be done.

Nussbaum has closed a fistula of this kind by a double suturing of the bladder and bowel; but the cases suited for this formidable measure are few. In many instances it would be impossible. Colotomy has given relief in some cases in which the fistula was situated low down in the colon, all the contents of the bowel being made to pass by the artificial opening.

Suprapubic cystotomy is not likely to be of service.

AFFECTIONS OF THE UMBILICUS.

Umbilical fistulæ.—The following fistulæ are met with at the umbilicus. Some are congenital, some are acquired: (1) vitelline duct fistula, (2) urachal fistula, (3), (4), and (5) fæcal, biliary, and purulent fistulæ. The first two named depend upon congenital defects.

1. **Vitelline duct fistula.**—The omphalo-mesenteric or vitelline duct may persist in part, as a tube passing from the lower ileum to the umbilicus. This tube has—when it exists—the structure of intestine. The amount of discharge from the fistula will vary with its lumen. When large a considerable quantity may escape. As a rule the tube is small, and the discharge is merely a little fæces-stained mucus. The intestinal segment of the persisting duct may be obliterated: in which case there may be nothing but an occasional bead of mucus noticed at the umbilical orifice.

The duct may extend as a patent tube for some distance into the cord, and may be divided when the cord is divided. The fistula, on the other hand, may not show itself until some time after birth. The umbilical cicatrix becomes sound and firm. Then there are signs of swelling and ultimately of suppuration beneath it. The pus escapes and a mucoid or fæcal discharge follows. In such case the tube has lacked an opening at the umbilicus, but has been patent beyond, although not of necessity as far as the intestine. The orifice of the fistula is usually marked by a papilla-like mass of granulations.

When the tube is very small, and when the umbilical segment is alone patent, it may escape notice as a fistula.

2. **Urachal fistula.**—This is not so common as the variety just described. When it exists, it depends upon a patent urachus. This tube may have so large a lumen as to form a free communication with the bladder, and to allow of a copious escape of urine. In some instances the patent urachus has been associated with some congenital narrowing of the urinary passages. The tube may be very minute and patent for only a short distance beyond the umbilicus.

When the fistula is large, the mucous membrane lining the urachus may protrude at the navel and form a prominent tumour. This condition is sometimes associated with congenital umbilical hernia. The fistula may open upon the summit of a small papilla, or at the bottom of a cup-like depression, or there may be more openings than one. The sinus may become evident at birth, or not appear until some time elapses, when an abscess leads to its demonstration, as in the vitelline duct fistulæ. The patent urachus may be the seat of acute or chronic catarrh. Urinary concretions have formed in it. (*See also Article LI.*)

Treatment.—The two forms of congenital fistula just described may undergo spontaneous closure. The larger varieties may form a necessary exit for pus, mucus, urine, or fæcal matter. Some of

the least significant will close after one or more applications of the actual cautery. If the sinus do not reach the viscus, and yet be patent for some way within the abdomen, there is nothing to be done but to excise it. If the cutaneous orifice be closed, the little tube soon becomes distended with mucus or muco-pus, and after causing much trouble the sinus forms again. The largest fistulæ which communicate freely with the bladder or ileum may be closed by a plastic operation, but the tube so closed is very apt to cause trouble at a later period. Some cases have proved almost incurable.

3. **Fæcal fistula.**—A fæcal discharge at the umbilicus may depend upon a patent vitelline duct, or upon a communication effected with the bowel as a result of some suppuration or malignant disease. The most common causes of the acquired forms are tuberculous ulcer of the bowel and tuberculous suppurative peritonitis. A few of these fistulæ result from injured or gangrenous umbilical herniæ. Epithelioma of the bowel may lead to fæcal fistula at the umbilicus.

The treatment of the patent vitelline duct has been just alluded to. Fistula due to tuberculous peritonitis are most difficult to close. Many close spontaneously; some will heal after they have been dilated, scraped, and drained. The majority lead into very long, complex, and tortuous passages, and the closure of such a fistula by operation is next to impossible (page 598).

The fistulæ due to cancer are, of course, not adapted for any operative measures.

4. **Biliary fistula.**—The distended gall bladder may reach to the umbilicus, may contract adhesions in that situation, and discharge there. The disposition of such fistulæ has been already considered (page 595).

5. **Purulent fistula.**—Certain of these depend upon suppuration in congenital fistulæ, the visceral terminations of which are closed (*e.g.* urachal abscess). Some are due to suppuration in vitelline or urachal cysts; others depend upon suppurative peritonitis, which is nearly always of tuberculous origin. A few have been due to suppuration extending from broken-down tuberculous mesenteric glands.

The treatment must be conducted upon the general principles which guide the management of ordinary sinuses.

Tumours of the umbilicus. Urachal cysts.—These are due to imperfect obliteration of the urachus, the fœtal tube being closed at both ends. The cysts that result have walls composed of muscular tissue like that of the bladder, and have a lining of mucous membrane. There may be one cyst or a string of cysts; they are usually small. They may, however, attain considerable size, and appear as large tumours between the peritoneum and the transversalis fascia. In one recorded case the cyst contained ten pints of fluid. They may give rise to much confusion when met with during the progress of an abdominal section.

They may suppurate and cause one form of urachal abscess. The only treatment is by excision. (*See* also Article LI.)

Vitelline cysts.—These, like those just alluded to, depend upon a like imperfect obliteration of the vitello-intestinal duct.

The wall resembles that of the bowel, and the cyst is lined with mucous membrane like that of the gut, and exhibits villi and gland follicles. These cysts are usually small. They may project internally or externally. When the latter condition obtains, they have been mistaken for a hernial sac.

The contents are mucoid and slimy, and sometimes chocolate-coloured. There may be a minute point of exit in the cyst wall. They may suppurate.

The treatment, when possible, is by excision.

Vitelline duct tumour.—Now and then a soft red velvety and solid tumour is noticed at the umbilicus of an infant. It will vary in size from a pea to a cherry. It has been aptly compared to a red currant. It may be sessile or pedunculated. It is composed of mucous membrane like that of the bowel, provided with intestinal glands, and associated with a certain amount of connective tissue, of unstriated muscle fibre, and inflammatory material. These tumours originate from the remains of the omphalo-mesenteric duct. They are easily treated by removal.

"Masses of granulations" are described as common at the umbilicus in infants. Many of these little red projections are vitelline duct tumours, and others are associated with minute imperfections in the vitelline duct or urachus. Possibly a few may be simple inflammatory granulations. If snipped off they do not return.

Other affections of the umbilicus.—Among these may be mentioned umbilical hernia, sarcoma, epithelioma, warts, syphilitic condylomata, and eczema.

PERITONITIS.

The term peritonitis is applied to an inflammation of the serous membrane, which lines the abdominal cavity, and covers more or less completely the abdominal viscera.

The peculiarities of the peritoneum.—(1) Its surface is very considerable and is probably, as Wegner states, as great as that represented by the whole integument of the body.

(2) The membrane possesses remarkable powers of absorption, as shown by the manner in which milk, blood, peptones, etc., are taken up. It is said to be capable of absorbing an amount equal to from 3 to 8 per cent. of the body weight. It is noticed that septic intoxication occurs quicker in peritoneal infection than in any other. Dirt, pus, and faecal matter are more dangerous to life when introduced into the peritoneal sac than when brought into contact with any other like cavity.

(3) The peritoneum offers a limited resistance to septic organisms and their products. Experiments upon animals and clinical experience in man show that it can safely dispose of a certain quantity of septic germs.

(4) No tissue in the body provides more favourable conditions for healing than does the peritoneum.

(5) The peritoneum does not show the same degree of vulnerability in all parts, nor are all portions of it alike in the manner in which certain lesions are responded to.

The part which is apparently most sensitive to infection, and which is most prone to rapidly-spreading and diffused inflammation, is that which covers the small intestine.

The parietal peritoneum has not so high a degree of susceptibility, and is not so apt to assume the diffuse and low form of inflammation.

The morbid changes in peritonitis are more marked and more advanced on the visceral layers and omentum than upon the parietal part of the membrane, and this circumstance is not always to be accounted for by the point of origin of the trouble.

(6) The peritoneum is possessed of great sensitiveness, a matter of moment in the production of shock. This sensibility appears to be dulled or lost when the surface of the serous membrane becomes inflamed and covered with lymph. The irritant which, of all others, appears to affect the peritoneum the most acutely is that represented by the invasion of the surface by certain bacteria or their products.

The abdominal nerve supply.—The general arrangement of the nerve supply of the parietes of the abdomen and of the abdominal viscera is peculiar. The skin over the greater part of the abdomen, over that part at least beneath which lie the chief viscera, is supplied by the lower seven dorsal or intercostal nerves.

The same nerves supply the muscles of the belly, namely, the rectus, the two oblique muscles, and the transversalis.

More than that, these identical nerves by their branches to the splanchnics take a most important part in the nerve supply of the abdominal viscera and of the peritoneum.

It is further to be observed, that these particular spinal nerves are concerned in the movements of respiration, since they supply the lower series of intercostal muscles.

It thus happens that an arrangement exists for the most rapid possible conduction of reflex impulses. A cold hand is laid upon the abdomen, or a blow upon the part is threatened, and the muscles of the belly wall become rigid in a moment; or it may be that there is some sudden lesion of the peritoneum or of one of the abdominal viscera, and at once the muscles of the belly wall contract, and a more or less marked hyperæsthesia of the skin develops, and there is thus provided, by the tender integument and by the rigid muscles, that protection and that securing of rest which are the first elements in the natural treatment of a damaged part.

That pain which the patient feels to be actually situated within the abdomen has the peculiarity that it is not as a rule to be localised at first, but is commonly referred to the great abdominal nerve centres. In the early stages of strangulated hernia or of perityphlitis, for example, the patient very often refers the pain to the region above the umbilicus, and will sometimes place his hand over

the site of the solar or superior mesenteric plexus. As symptoms progress the localisation of the pain becomes usually more precise, assuming that the trouble still remains, in great part, local.

Peritoneal shock. Peritonism.—Certain symptoms which are collectively known as the phenomena of *shock*, mark, almost without exception, the clinical beginnings of those cases of peritonitis which are abrupt in their onset, or acute, or even subacute in their course. These symptoms are evidently entirely due to an impression upon the nervous system, and are independent of inflammation on the one hand or of septic intoxication on the other. Certain experiments by Reynier and Richel may be mentioned as illustrative of this statement. They injected boiling water into the peritoneal cavity of a rabbit. The phenomena of shock were at once produced, the temperature sank to 29° C. and the animal died, collapsed, within twenty-four hours. The more extensive the scald the more marked was the shock. In no case was any peritonitis produced.

In the human subject the shock attending a severe peritoneal lesion may prove fatal, and the patient may die with evidence of no important disturbance other than that wrought directly through the great nerve centres.

The signs of sudden and grave disturbance of the peritoneum are pain, profound exhaustion, a distressful anxiety, pallor, a small, soft, quick pulse, cold extremities, shallow respiration and vomiting. It is interesting to note that these symptoms are, in some degree, common to *all* cases in which there has been a rude and abrupt impression made upon the nerve centres within the abdomen. It may almost be said that all quite acute troubles within the abdomen commence with the same train of symptoms. Until some hours have elapsed it is often impossible to say whether a sudden abdominal crisis is due to the perforation of a vermiform appendix, or to the bursting of a pyo-salpinx, or to the strangulation of a loop of intestine, or to the passage of a gall stone. The twisting of the pedicle of an ovarian cyst has led to symptoms which have been mistaken for perityphlitis, a sudden peritoneal hæmorrhage has been confused with intestinal obstruction, and the rupture of a hydatid cyst has been diagnosed as a perforation of the intestine. To these common phenomena of a crisis within the abdomen Gübler has applied the convenient term of *peritonism*.

Morbid anatomy of peritonitis.—The morbid changes in peritonitis differ in no essential from those which mark the inflammatory process in other serous membranes, such as the pleura or the synovial sacs.

In the early stage there is *increased vascularisation* as shown by more or less diffused capillary injection. The parts affected become reddened, and now and then this reddening is intense. It is apt to be irregularly distributed, and on the intestines is very prone to follow the lines where the various coils of bowel touch one another. Sometimes the injection is especially marked along two lines which

are not far apart, which are in the long axis of the bowel and parallel with the attachment of the mesentery.

The *inflammatory exudation* varies considerably, both in character and amount. It may take the form—and this is usual in the early stages—of a plastic lymph upon the surface of the membrane. This may be so slight as to cause the peritoneum to be merely dull and lustreless, and to feel sticky to the fingers when handled.

If the plastic lymph be more extensive in amount it assumes the form of a coating or layer of yellowish-grey colour. This is at first very soft and easily separable, but later it becomes firmer and more adherent, and is added to until it may attain a considerable thickness. This exudation is seldom evenly distributed. It may appear in patches, or even in flakes. It is commonly most uniform and thickest along the lines of contact between adjacent coils of bowel. It mats the intestines together and covers over the solid viscera. Over these organs it may attain a considerable depth. With this fibrinous exudation there may be some serous fluid associated, but it is usually small in amount. To these appearances is given the name of **plastic** or **adhesive peritonitis**. If the patient recover, the lymph becomes more or less absorbed, and what remains organises, forming adhesions of varying length, extent, and density.

In other cases of peritonitis the amount of the fibrinous exudation is slight, while the peritoneal cavity is occupied by a serous effusion. This is usually rendered turbid and of a milky or greenish-yellow colour by flakes and fragments of lymph which float in it. To this form the name of **sero-fibrinous** or **sero-purulent peritonitis** is given. In some chronic cases the effusion may be quite serous and not unlike ascitic fluid—**serous peritonitis**. If recovery follow, the exudation is absorbed more or less completely, a few adhesions—which are mostly flimsy—developing.

In another grade of peritonitis the exudation is distinctly purulent. When the effusion is encysted it may have all the character of pus. More usually it appears as a watery purulent fluid of a yellowish-grey or greenish colour, which is markedly offensive. This effusion may be more or less stained with blood pigment. To the condition thus described the name of **purulent peritonitis** is given.

In a few rare instances the effusion has been gelatinous or colloid in character.

In all cases there is more or less swelling of the sub-peritoneal tissues. The intestines are greatly distended with gas, and their walls are infiltrated and softened.

Fætid gas may be present in the peritoneal cavity either from decomposition of the inflammatory exudation or, as is more usual, from perforation of the bowel.

Peritonitis may be more or less **general** or **diffused**, or it may, on the other hand, be **local** or **circumscribed**. In the latter instance the inflammatory focus is shut off from the general

peritoneal cavity by means of adhesions, and in the formation of this protective barrier the great omentum often takes an important part. Examples of local peritonitis are afforded by perityphlitis, pelvic peritonitis, and certain forms of subphrenic peritonitis.

The description given above applies especially to *acute* peritonitis. When the trouble is **chronic** the same general changes are to be observed. The adhesions are thicker, more numerous, and more dense in the majority of cases. In some instances there may be considerable tracts of fibrous thickening which involve the membrane, and mat the tissues and viscera together in an extraordinary degree. The whole omentum may be represented by one confused hardened mass. Many loculi containing inflammatory effusions are often found here and there. The involved membrane may be more or less deeply pigmented. The effusion may be serous, sero-purulent, or purulent.

One form of chronic peritonitis—that known as **tuberculous peritonitis**—is dealt with on page 619.

Peritonitis may—as an accident—complicate malignant disease when it invades the serous membrane, but there is no such affection as “cancerous peritonitis.”

The causes of peritonitis.—It has become evident that peritonitis depends almost entirely, if not entirely, upon *infective processes*, and that these agencies are concerned, directly or indirectly, in every form of the disease.

In dealing with any classification in which an infective process is the main element there are many general considerations to be borne in mind. On the one hand there is the *dose* of the poison, and on the other hand there is the *soil* into which it is introduced. The dose must obviously be liable to considerable variations, not only in amount but also in virulence, while the conditions offered for growth by the inoculated body must differ to even a wider and more complex extent.

The *resistance of the individual* to the growth of septic organisms is influenced by a multitude of circumstances, the value of which is scarcely susceptible of being formulated. There are the factors of *age* and of *health*, and of such unfavourable affections as Bright's disease, diabetes, and alcoholism. There are *local conditions* which lend themselves to the more ready cultivation of germs, such as extensive damage to the peritoneum, and extensive interference with its functions of absorption—or, at least, with that ill-understood power it possesses of dealing with noxious micro-organisms. There are the presence of ascites, and the co-existence of extravasations of blood, bile, or intestinal matter in the peritoneal cavity. There is, finally, the entirely undefined peculiarity of the individual which alone appears to render one man susceptible and another comparatively exempt.

The following classification of peritonitis according to its causes appears to be justified by our present knowledge of the subject.

The three chief forms are placed in the order of the frequency with which they occur :—

1. Peritonitis due to infection from the intestine.
2. Peritonitis due to infection from without.
3. Tuberculous peritonitis.
4. Peritonitis of doubtful origin.

(1) Peritonitis due to infection from the intestine.—

Under this heading are included most cases of peritonitis associated with hernia, with intestinal obstruction, and with perforation ; peritonitis due to any form of ulceration of the bowel ; to enteritis ; to cancerous growths of the gut, and to troubles in the appendix. There will also be included peritonitis due to inflammatory changes in the biliary canals, and some forms of peritonitis following upon operation.

The micro-organism which is usually found associated with these different forms of peritonitis is the *bacterium coli commune*. (See p. 40, Vol I.).

The *bacterium coli commune* exists normally in the human body, and is found in individuals in a state of perfect health. It has been demonstrated to be present along the whole length of the alimentary canal from the mouth to the anus. Its natural habitat is the bowel. It is said to be especially numerous in the duodenum and in the colon, and has been found in the bile-passages.

It is the most abundant and the most constant of the bacteria found normally in the human body.

This bacterium has an important peculiarity in that it appears to vary in virulence. So far as experiments upon animals are of value it would seem to be quite harmless when taken from the normal intestine. A culture of the bacillus so obtained has no effect when injected into the peritoneum of animals.

If, however, the bowel become the seat of certain diseased conditions (or it may almost be said of *any* diseased condition), then the bacillus becomes at once virulent.

Virulence has been found to be developed in cases in which the bowel was obstructed, strangulated or inflamed, in venous congestion of the gut, in œdema of the bowel wall, in diarrhoea, in typhoid fever, and in cholera.

It also appears to develop qualities for evil in instances of advanced constipation.

When the intestine is healthy, the *bacterium coli commune* has little disposition to escape through the gut wall or to invade the tissues of the body after death. If, however, the intestine be damaged or diseased, then the bacterium shows an active inclination to penetrate through the bowel wall, and is usually found to have invaded the tissues after death.

The effect of injecting a culture of the virulent colon bacillus into the peritoneum of animals varies—other things being equal—according to the dose. In the slightest cases the animal, after an

illness in which diarrhoea is often a symptom, recovers. In another grade a localised purulent peritonitis is produced which follows a chronic course. In a third degree death is rapidly brought about by a diffuse fibro-purulent peritonitis. In instances in which a large dose is employed, the animal dies of acute sepsis before any phenomena of peritonitis are produced.

The presence of fluid in the peritoneum and especially of blood, greatly aids the development of peritonitis in these experiments.

So far as the human subject is concerned, it has been shown that those various forms of peritonitis which are assumed to be of intestinal origin depend mainly, and in many instances solely, upon the *bacterium coli commune*.

It is evident that the irritant which induces the peritonitis and which reaches it from the intestine may follow more than one path. (a) Bacteria may escape through a perforation in the bowel; (b) they may pass through the wall of a segment of intestine which has been in some degree damaged, but not perforated; and (c) chemical products of bacteria may reach the peritoneum by either of these routes.

2. Peritonitis due to infection from without.—This class will include puerperal peritonitis, peritonitis consequent upon inflammatory troubles in the genital organ or in the parietes of the abdomen, and some forms of peritonitis following upon operation.

The micro-organisms usually associated with the varieties considered in this class are *pyogenic cocci* (p. 25, Vol. I.). Of these the streptococcus is the one most usually met with. It is often alone, or it may be associated with other micro-organisms, among which, however, it is the chief.

That the streptococcus is the usual agent in puerperal peritonitis has been shown by many.

The staphylococcus is very rarely met with alone in cases of peritonitis, and is usually associated with the more virulent form of coccus.

The pyogenic cocci, and most usually the streptococci, have been found in cases of peritonitis after operation in man, and experiments upon animals show how the noxious effect of those micro-organisms may be assisted by extravasations in the peritoneal cavity, by long exposure of the peritoneum, and by damage to its delicate surface.

In the operation cases it is most probable that the streptococcus gains an entrance through the wound. In puerperal peritonitis it, no doubt, reaches the abdomen through the pelvic organs following the veins, or lymphatics, or the Fallopian tube. In the rare examples of peritonitis associated with erysipelas of distant parts (such as the face) the streptococcus must be assumed to reach the serous membrane through the blood.

3. Tuberculous peritonitis.—This form of peritonitis

depends upon the tubercle bacillus. It involves certain peculiar features in its pathology and treatment, and is dealt with in a separate section on page 619.

4. Peritonitis of doubtful origin.—Under this purposely indefinite heading it will be convenient to group:—(a) Peritonitis due to the pneumococcus; (b) peritonitis due to irritants; (c) forms of the trouble reputed to depend upon rheumatism, gonorrhœa, syphilis, Bright's disease, and alcoholism; and (d) peritonitis of the newly born.

(a) *Peritonitis due to the pneumococcus* has not yet been proved to possess an indisputable existence.

In the first place, the connection of the pneumococcus with pneumonia is a subject about which there is much conflicting evidence. In the second place, peritonitis is a rare sequela to pneumonia, although it is true that pneumonia is not an uncommon complication of peritonitis. Then, again, the pneumococcus has been found in the peritoneum in cases of fatal pneumonia, and yet there has been no peritonitis. On the other hand, cases of peritonitis have been reported by many in which the pneumococcus appears to have been the cause of the trouble, and was, indeed, the sole micro-organism found. The peritonitis in some of these cases was primary, and was the only disease; in the other instances it was secondary to pneumonia.

The pneumococcus would seem to be at one time noxious to the peritoneum, and at other times to be harmless.

(b) *Peritonitis due to irritants.*—On the subject of this form of peritonitis there is much conflict in opinion.

Bumm maintains that a non-infective peritonitis may be produced by mechanical, chemical, or thermal irritants, and states that it is usually plastic and localised.

Pawlowsky injected sterilised croton oil into the abdomens of twelve animals. Of this number eight died from hæmorrhagic peritonitis, and neither pus nor micro-organisms were found in the exudation, nor were there any signs of sepsis.

As a comment upon these experiments, it may be noted that pyogenic cocci (*e.g.* the staphylococcus aureus) will act more readily, and in smaller doses, if introduced into the peritoneum together with some corrosive fluid capable of injuring the serous endothelium, and further that such injury to the peritoneal surface—in cases in which no cocci are injected—encourages the escape of the colon bacillus from the intestine.

Fränkel injected irritants into the peritoneum of certain animals. Peritonitis followed. If the exudation were examined at an early stage, or in the slightest cases, it was found to be clear and free from micro-organisms. If, however, the case were advanced, the exudation was purulent and swarming with bacteria which had passed through the bowel wall.

Fæces, if introduced into the peritoneal cavity, cause peritonitis, not by chemical action, nor as an irritant, but by reason of the

micro-organisms or their products contained in the extravasation. If the material be sterilised no effect follows.

The same results have attended the injection of human bile into an animal's peritoneum. When the bile was untreated peritonitis usually followed, but when it was sterilised the injection was attended by no evil results.

According to Naunyn, normal bile is sterile. According to Létienne, it may contain bacteria. It is said by others to be sterile so long as it contains free biliary acid.

In inflammatory conditions of the bile passages the bacterium *coli commune* is commonly found.

It has been shown that in man a considerable effusion of bile may take place into the peritoneal cavity without causing peritonitis.

Blood is not of itself capable of producing peritonitis, although it affords a very favourable condition for the development of any bacteria which may gain access to the extravasation.

(c) Spillmann and Ganzinotty have collected fifteen recorded cases of *rheumatic peritonitis* with nine deaths. In some of these cases the peritonitis appeared alone, in others in association with rheumatic troubles in the joints, or in other serous membranes.

The evidence, however, upon which the pathological assumption depends is by no means satisfactory.

Peritonitis has been met with in association with *gonorrhœa*, but inasmuch as the gonococcus will not survive in the peritoneal cavity, it is to be assumed that pyogenic cocci have found a nidus in the discharge from the genitals and have spread by extension to the peritoneum.

The peritonitis reputed to be due to *Bright's disease*, to *alcoholism*, and to *syphilis*, has not been shown to have a specific ætiological existence. It would seem rather to occur under conditions that are very favourable to bacterial growth, or to be due to extension from parts that are already inflamed.

(d) The peritonitis met with in the *newly born* appears to be due to one of two conditions. It may depend upon puerperal infection, and be brought about by direct extension from the cord, which is found to be inflamed, or gangrenous, or the seat of an actually erysipelatous condition. Or it may be due primarily to the giving way of the bowel in cases of imperforate anus.

Relative frequency, age, sex, and mortality.—The table on page 612 deals with one hundred cases of peritonitis from the records of the London Hospital. It serves to show the relative frequency of the various forms of peritonitis, the fact that the affection is more common in females than in males, and that it belongs mainly to adult life.

The mortality is at the rate of 70 per cent. The larger proportion of recoveries belong to the cases of pelvic peritonitis and to those due to mischief in the vermiform appendix. The great fatality of peritonitis due to hernia, perforation, disease of the bowel, and to injury is very evident.

PERITONITIS.		Number of Cases.	Sex.		Average Age.	Result.	
			Males.	Females.		Deaths.	Recoveries.
Class I. 47 Cases.	{ With hernia	10	3	7	52	10	0
	{ With perforation of bowel ...	9	4	5	40	9	0
	{ With gross disease of bowel ...	6	4	2	40	6	0
	{ With disease of appendix ...	22	19	3	22	6	16
Class II. 33 Cases.	{ Starting from lesions about the pelvis	18	5	13	36	11	7
	{ Following abdominal wounds ...	14	2	12	36	14	0
	{ By extension from the pleura ...	1	0	1	32	1	0
Class III. 8 Cases.	{ Tuberculous	8	2	6	20	5	3
Doubtful. 12 Cases.	{ Diffuse sarcoma of peritoneum ...	2	2	0	42	2	0
	{ Causes of peritonitis unknown ...	10	2	8	29	6	4
		100	43	57		70	30

Symptoms of acute peritonitis.—It will be readily understood that the symptoms of acute peritonitis are liable to considerable variation, both in character and degree. In the following account the phenomena attending what may be regarded as a typical case are considered.

The *onset* is sudden, and in only 13 per cent. of the cases is there an initial *rigor*. Rigors are most common in examples of pelvic peritonitis.

The patient is seized with pain, exhibits the phenomena of shock or collapse and vomits. The *pain* is intense and widely diffused. It is often at first vaguely located about the umbilicus, and is spoken of as gnawing, burning, agonising. It is not the griping pain of colic. Later, the pain may exhibit exacerbations, due probably to peristaltic movements. The *collapse* is of the kind mentioned under the title of peritonism (page 605). The patient becomes faint, pale, and utterly prostrated. His pulse fails, his skin breaks out in a cold perspiration, and his face exhibits the physiognomy of exhaustion, pain, and terrible distress. As time progresses this condition of collapse becomes less marked.

The *vomiting* appears early, and is an almost constant and persisting symptom. At first the contents of the stomach are returned, the vomited matter alternately becomes bilious, and finally brownish and offensive. It may finally become fæculent, but this is rare.

When the peritonitis is well established the condition of the patient is characteristic. He lies rigid in bed, helpless, and distressed. He is restless, and expresses his unrest by incessant movements of his hands and incessant complaints.

The *abdominal walls* are usually at first sunken in, and in some cases of perforative peritonitis this contraction of the belly wall may be extreme. They then become rigid and board-like, and the abdomen—except in corpulent subjects—is flat. There is very considerable tenderness to the touch, which depends mainly upon hyperæsthesia of the skin. The patient is often unable to bear the gentlest handling, and may even not be able to suffer the bed-clothes to rest upon the abdomen. In these cases deep pressure may sometimes be borne if gradually applied.

Later, as meteorism appears, the abdomen becomes more swollen, is rounded and barrel-like. The extreme hardness of the muscular wall is less noticeable, and towards the close of the case the parietes, now much distended by meteorism, may become comparatively flaccid. Abdominal respiration ceases, the movements of the chest are exaggerated; the patient, in order to relax as much as possible the strain upon the abdominal muscles, lies with his knees drawn up and with his hands above his head. This *attitude* is very characteristic.

The degree of *meteorism* in peritonitis varies considerably. It may be absent throughout the whole progress of the case, and examples of this are not uncommon in instances of septic intoxication attended with symptoms of a low type. It is most marked in peritonitis attended by actual intestinal obstruction, in examples of perforation, in cases in which there is thrombosis of the mesenteric vessels, and also in instances in which opium has been freely administered.

It has been often assumed that meteorism depends upon obstruction in the lumen of the bowel, and that it is due to an accumulation of gases in the intestine above the occluded point. These assumptions are not supported either by clinical experience or by experiments upon animals. It is true that the distended gut is entirely paralysed, and that it remains "paralytically fixed" in the abdomen; but even when actual obstruction exists it cannot be shown that the meteorism is always greater the lower down in the tube the occlusion is placed.

Experiments make it evident that gas may be developed in an intestine emptied of its contents, and that meteorism, as met with in disease, depends almost entirely upon gross disturbances in the circulation of blood through the affected portions of intestine.

On *percussion* a tympanitic note may usually be expected in peritonitis. The stomach is not infrequently dilated. The normal dulness over the liver and spleen is diminished, or obliterated. When there is general effusion it shows itself, if sufficient in amount, by dulness in the flanks.

When the patient rolls over upon one side the dulness disappears

from the flank which becomes uppermost. In cases of localised peritonitis, as that due to mischief about the appendix, the area of dulness in the affected district is often very precisely marked, and is uninfluenced by position. Moreover, the dull area is usually the seat of the most marked tenderness and pain. When suppuration takes place the integuments over the affected area may become cedematous and red.

Constipation is usually marked in peritonitis. In 28 per cent. of the cases, however, there is a more or less free or "loose" action of the bowels.

The *temperature* in peritonitis is liable to such extreme variations that no certain type of fever can be described. No regular relation exists between the range of temperature and the character of the peritoneal effusion.

The most robust evidences of fever are met with in cases of plastic peritonitis associated with localised suppuration.

In peritonitis due to strangulated hernia the temperature is usually low, and does not rise above 99.5.

In rapid cases of perforation the temperature is below normal, and is that of collapse.

In peritonitis attended with gross disease of the bowel the temperature is disposed to rise steadily and then to drop somewhat abruptly before death. The peritonitis due to mischief in the appendix is usually high and of the ordinary inflammatory type. The same may be said also of pelvic peritonitis, in which the features of septicæmia are often marked in the temperature chart.

The *pulse* is at first small, sharp, hard, and wiry, and almost characteristic. It ranges from 120 to 160 on an average. Towards the close of the case—should death ensue—the pulse becomes softer and feebler, and is at last uncountable. The respirations are increased.

As to the patient's *general condition*, the face is pinched and withered and of an ashen colour, the eyes are sunken, the lips are blue. There is intense restlessness and anxiety, profound prostration, and utter loss of appetite. The tongue is furred, red, and dry. There is a foul taste in the mouth, and constant and intense thirst is one of the most distressing features of the disease. The urine is scanty and high-coloured, and there is a copious deposit of urates as a rule. Frequent micturition, or, on the other hand, retention, is not uncommon. There may be headache and delirium, but usually the patient remains sensible until the last. Now and then there may be a little jaundice as shown by the yellowish skin.

In no less than 17 per cent. of the cases of peritonitis either pneumonia or pleurisy may be expected as a complication.

Variations in the symptoms.—It will be impossible to deal in detail with the many clinical phases of peritonitis. In general terms it may be pointed out that the symptoms are mainly those of septic poisoning, and a man dying of peritonitis has very much the aspect of one dying of snake poisoning or of the poison of cholera. There is an adynamic form of peritonitis which is sometimes

seen in instances where the features of septic intoxication are marked, or where peritonitis attacks the subjects of Bright's disease or advanced age. In such cases the patient sinks into a typhoid condition and dies. There may be little pain, there may be no constipation. Vomiting will be present, but it will be slight. There are utter prostration, a cold damp skin, and a rapidly-failing pulse.

The vomiting in peritonitis is usually slight in amount; only an ounce or so of fluid being ejected at a time. The vomiting may cease under the influence of morphia, and there may then be a great gush of vomit from the mouth and nose just before death.

In cases of peritonitis following upon *strangulated hernia* the vomiting is for the most part very marked and copious.

In *perforative peritonitis* all symptoms are usually acute and pronounced. There is intense pain and a corresponding degree of collapse, and in the larger proportion of the cases vomiting is conspicuous. It is usually absent in examples of perforation of the stomach.

In cases of peritonitis depending upon *disease of the intestine*, including mischief in the appendix, vomiting is not, as a rule, a pronounced symptom.

In peritonitis taking its origin from the *pelvic viscera or parietes*, vomiting is seldom very distressing. In the acute cases the symptoms are rather those of septicæmia, and in the chronic cases the disturbance has a great disposition to remain localised.

Course and termination.—The mortality of peritonitis has already been alluded to (page 611). Death takes place, in the acute cases which end fatally, in from thirty-six hours to seven days. Death is usually due to toxæmia. In certain less acute cases pneumonia appears to produce the fatal issue.

In instances of localised peritonitis a collection of pus may form: this may burst through the skin, may burrow in the subperitoneal tissue, may escape into the peritoneal cavity or into the bladder, or some part of the alimentary canal.

Symptoms of chronic peritonitis.—A chronic course is observed in most cases of tuberculous peritonitis, in certain cases of perityphlitis and of pelvic peritonitis. In these instances the extended duration of the symptoms depends rather upon the course taken by the inflammatory exudations than upon a persisting inflammatory change in the peritoneum. A very indolent and almost negative form of peritonitis, so far as marked symptoms are concerned, is met with in a few instances of malignant disease of the peritoneum, and of ascites after paracentesis has been carried out.

A concise account of the clinical phenomena of chronic peritonitis is scarcely possible, owing to the irregular and peculiar course of this form of the disease. The best type is that afforded by tuberculous peritonitis, and to the account of that affection the reader is referred (page 619).

The treatment of acute peritonitis. 1. **Rest.**—Absolute rest in the recumbent position is the first obvious indication. The

knees may be flexed over a pillow to lessen the tension on the abdominal walls. The upper part of the chest and the upper limbs should be protected by woollen clothing.

2. **Feeding.**—The rule of giving as little food as possible by the mouth cannot be improved upon. Two extremes are to be avoided—the unreasoning and often cruel prohibition of food of any kind by the mouth on the one hand, and the intemperate use of ice or iced fluids on the other.

If there be—as is usual—a raging thirst, let the patient have a little ice, or a little iced milk and soda water, or if the inclination lies towards something warm, let him take a few spoonfuls of hot water or of weak tea made hot, or of beef tea at a like temperature. It is not so much the nourishment that the patient needs as some fluid in the stomach. Thirst is best relieved by an injection of half-a-pint of water by the rectum.

Actual feeding, in the usual sense, may be carried out by means of nutrient enemata. These must be given with the usual precautions, and with the knowledge that as the case advances they may very probably have to be discontinued.

If there be diarrhoea then rectal feeding cannot be adopted, but, fortunately, in these cases the vomiting is often slight, and fluid and a certain amount of nourishment can be taken by the mouth.

It is perhaps needless to add that in cases, with or without diarrhoea, in which there is no vomiting, all that is given may be given by the mouth.

3. **Opium.**—Give as little opium as is possible. In the early stages of acute peritonitis, and especially in the perforative forms, and in those depending upon appendix troubles, morphia in the form of a hypodermic injection is absolutely necessary. In the worst instances, it may certainly avert death from shock. Under its influence the patient revives, and the more intense symptoms become greatly modified.

Morphia should never become a feature in the routine care of peritonitis. It masks the symptoms, hinders the natural process of cure, and hampers treatment.

The indication for it is actual pain, and not mere restlessness and misery. In the really septic forms but very little morphia is called for, and often none at all. I have found in these cases that an injection of strychnine ($\frac{1}{30}$ gr.) will often give more relief than the narcotic.

4. **Aperients.**—Aperients can never be adopted in the routine treatment of peritonitis. In the larger proportion of cases purgatives are entirely useless, and would merely add to the patient's distress. In the great series of the markedly septic forms their employment is more or less impracticable. Theoretically, an aperient, in cases of peritonitis starting from the intestine, should be of service, since it would be expected to rid the bowel of at least some of the noxious matter from which the peritoneum has been infected.

It has, however, been pointed out by Mr. Tait and has been made evident to most surgeons who have followed his teaching, that if an action of the bowels can be obtained at the outset of the symptoms, either by the administration of a purgative or by an enema, the trouble in a certain proportion of cases passes away and the patient makes a good recovery. It cannot be said that this good result follows in all cases, and it is evident that the purgative, like the emetic given in acute poisoning, can only bring about an arrest of the symptoms within certain limits.

When once general peritonitis has established itself, an aperient is entirely without avail. In those septic cases in which diarrhoea occasionally sets in, this is only too apparent.

5. Blood-letting.—This measure of treatment may with advantage be more extensively employed. In robust forms of localised peritonitis, blood-letting is attended with admirable results. In perityphlitis the application of half-a-dozen leeches often acts with magical effect.

6. Operative measures.—These are represented by incision and drainage, with or without irrigation. This treatment must be considered as it applies to peritonitis, under two entirely different aspects. In one series of cases there is vigorous well-defined inflammation, the local symptoms are marked, pus is produced, and may be considerable in amount, and the exudation is more or less clearly localised. Examples under this heading are afforded by peritonitis started by mischief in the vermiform appendix, by many forms of peritonitis within the pelvis, and in the subphrenic region, and by certain cases of limited inflammation following on injury or perforation.

In the other series of cases the peritonitis is diffused, the constitutional symptoms are more prominent than the local ones, the changes in the serous membrane—so far as evidence of inflammation is concerned—are comparatively slight and out of proportion to the general disturbance. This form is illustrated by cases in which there is a general septic intoxication starting from the peritoneum, by peritonitis due to perforation, or following after strangulated hernia or enteritis, by puerperal peritonitis, and by examples of genuine peritonitis following operations within the abdomen.

In the first series of cases surgical interference by incision and drainage ranks with the procedure of evacuating a large abscess.

In the second series the cut into the abdomen and the subsequent flushing out or drainage, are to be compared with the washing out of the stomach after an active poison has been swallowed.

In the one case the body has to be rid of the products of a robust and possibly limited inflammation; in the other case an attempt has to be made to remove from a cavity a poison which has already wrought no little harm. The operation in the latter instance is directed not so much against an inflammatory outbreak as against a progressive poisoning.

The operative treatment of suppurative peritonitis, especially when the effusion is localised, has been remarkably successful.

The operative treatment of general diffused non-tuberculous peritonitis has, so far, no great record to boast of. Surgical treatment has been most discouraging in acute peritonitis following upon gangrenous hernia, upon operation, and upon puerperal infection. It has met with but little better results in cases of perforation, in which the serous inflammation has been well established. In the acute diffused forms of peritonitis it is well not only to evacuate the peritoneal cavity, but also to empty the distended bowel through a trochar puncture which can be closed by sutures.

In cases of *localised purulent peritonitis* an incision should be made into the collection by the most direct route. When the pus has escaped, a rubber drainage-tube of suitable size, and with stiff fenestrated walls, should be passed to the bottom of the cavity. A dressing of some absorbent material, such as Tillmanns' paper, sal alembroth, or cyanide gauze is then applied.

At the end of twenty-four or thirty-six hours the irrigation of the cavity may be commenced, and continued twice daily, and now and then a little iodoform emulsion may be introduced.

In cases of *generalised peritonitis* the procedure adopted must obviously depend upon the cause and degree of the trouble. If the exudation be serous, it will suffice if the fluid be evacuated through a median incision, if the peritoneal cavity be gently dried in its most dependent parts by means of gauze sponges, and if the abdomen be closed without drainage.

When the exudation is sero-purulent or purulent it is in many cases desirable that the cavity be irrigated. The fluid which appears to be best suited for this purpose is a sterile 6 per cent. salt solution at blood heat. The irrigating tube is of soft rubber, and may have a diameter of three-fourths of an inch. The solution should flow gently into the abdomen. The peritoneal cavity is to be flooded, and not scoured out. After the washing, the depths of the cavity are dried, so far as is possible, with sponges; iodoform powder (except in children) is dusted over the portion of the serous membrane most involved, a long rubber fenestrated drainage-tube may then—in suitable cases—be introduced and the abdominal wound be closed. Any treatment directed against the cause of the peritonitis will be independent of these measures.

In order not only to rid the peritoneum of septic matter, but to allow the noxious accumulation within the bowel to escape, it may be well to evacuate the intestine through a trochar puncture before the operation is concluded. The opening so made can be closed by sutures.

There are cases in which the peritonitis is more plastic in character. The intestines are found to be matted together with greyish lymph, which may be present in considerable quantity. The breaking down of these adhesions causes no little amount of bleeding, and such a step is evidently destructive of a certain desirable process of repair. Still, in order to search for the cause of the peritonitis, assuming such search to be indicated, and to set free

an amount of exudation which is imprisoned between the attached coils, this freeing of adhesions must be, to a certain very limited extent, carried out. There will probably be a sero-purulent exudation in the belly cavity, and the gentlest movements of the fingers among the recently-attached intestines will set free more fluid, which will be probably less opaque. A clump of adherent intestines will often cover and protect a perforation, and the ubiquitous lymph will many times close such an opening with greater speed and more security than are provided by any system of suturing.

As the surgeon therefore reaches what appears to be the starting-point of the peritonitis, he must proceed with the utmost caution, and be not only prepared, but rather inclined to leave the actual cause of the trouble undemonstrated.

In this form of peritonitis a liberal dusting of the serous membrane with iodoform should be carried out (except in cases in children). Drainage is seldom required, and when employed is best provided for by strips of iodoform gauze passed among the intestinal coils to the necessary depth.

Irrigation is certainly not suited to this class of case. Gauze mops or sponges in holders form the best means of clearing the peritoneum in the circumstances named.

TUBERCULOUS PERITONITIS.

Age and sex.—No age is free from tuberculous inflammation of the peritoneum. It appears to be most common between the ages of twenty and forty, while it is also frequently met with in children.

Statistics obtained from post-mortem records appear to show that tuberculous peritonitis is more often met with in males, while the list of cases treated by operation shows that the majority of the patients operated upon are females. The latter circumstance has been explained by the fact that in women the peritonitis often starts from the pelvic organs, and presents itself in a form which suggests and encourages operative treatment; whereas in males the condition is apt to be more general, and to be associated with primary tuberculosis in a less favourable position, or to appear in a form less suggestive of operation.

Clinical phenomena.—These follow no uniform course, and are susceptible of infinite variation. Sometimes the trouble begins acutely with rigor and fever, attended by digestive disturbances, irregular bowels, colicky pains, and the local manifestations of peritonitis. Certain cases have in their early symptoms resembled typhoid fever. In an isolated example or so the first manifestations have been mistaken for those of perforative peritonitis.

In the great majority of instances the onset is quiet and stealthy. There are some disturbance in the functions of the stomach and intestine, some trifling colic, a steady swelling of the abdomen, and above all a steady wasting. There is irregular fever and a marked

fitfulness in all the symptoms. Constipation alternates with diarrhœa, and vomiting may become a notable symptom. In the course of the disease remissions and relapses and periods of unaccountable improvement are common, but in spite of any hopeful signs there is a general evidence of losing ground and of undoubted declining.

The abdomen becomes considerably swollen, and may exhibit almost every possible gradation and combination of tympanites and dulness on percussion. More or less exudation is usual, and this may be general or may be confined to one or more districts; the intestines may be matted together into a cyst-like mass, the omentum may be rolled up into a solid ball, not to be readily distinguished from a substantial growth. Adhesions may lead to a multitude of curious phenomena, discoverable on palpation. Here may be an area of resistance, and there a void; here all the manifestations of coils of intestine bound down by bands and fillets, and there the sign of bowel floating free in a thin fluid. There may be the phenomena of abscess on one side of the abdomen, and the physical signs of ascites on the other.

It is needless to say that tuberculous peritonitis is very commonly the subject of a mistake in diagnosis.

The curious mimicry met with in this disease has led to the diagnosis of cyst of the mesentery or liver, of tuberculous kidney, of ovarian tumour, of malignant growth of the omentum or peritoneum, of perityphlitic abscess, of internal hernia, and of fibroma and sarcoma of the abdominal wall. The symptoms of tuberculous peritonitis are discussed further in dealing with the three forms of the trouble. (See page 621.)

Morbid anatomy.—The morbid anatomy of tuberculous peritonitis follows, moreover, no more regular lines. From an examination of bodies after death, it would appear that tubercle may reach the peritoneum direct from the pleura, through the diaphragm, or may spread to it from the intestine, or from a tuberculous mesenteric or retro-peritoneal gland, or may have had its starting-point in some tuberculous disease of the female generative organs.

Tuberculous peritonitis may be the only manifestation of tuberculosis, although it is more usually secondary to a like process elsewhere.

In the majority of cases a large quantity of exudation is present: the peritoneum is opaque, it tends to become thickened, and the intestinal loops are prone to adhere together, and the adhesions thus formed may be very firm.

The omentum is commonly rolled upwards, and is found adherent to the anterior abdominal wall. Its layers are matted together, and often show extensive tuberculous changes.

The mesentery tends to become thickened, but not to be so shrunken as the omentum. The intestines are usually distended, and the belly markedly and uniformly swollen. The umbilicus is often protruded.

The ascitic fluid present usually shows 3 to 5 per cent. of

albumen. It is slightly opaque, greenish-yellow, and but seldom blood-stained. In this exudation the tubercle bacillus is but rarely to be demonstrated. The fluid may persist after the tubercles have disappeared. Peritoneal effusion may depend upon tuberculous trouble in the retro-peritoneal tissue. (See also the description of the three forms of tuberculous peritonitis given below.)

Now and then the mesenteric glands are found to be the seat of extensive tuberculous changes. They are seldom, however, conspicuous in the marked cases of peritonitis. The instances in which they are most prominent are commonly those in which there is either no peritonitis, or but a slight manifestation of it. These glands, when matted together, may form a large single tumour, which has been mistaken for an enlarged spleen or a movable kidney, or they may form many large and independent tumours, or numerous small and isolated glands may be found dotted over the whole of the mesentery. In some cases the limited glandular tumours have been removed successfully by operation. I have treated several cases (mostly in adults) in this manner.

Intestinal obstruction is not uncommon, as a result of tuberculous peritonitis, and may depend upon bands, upon the bending or kinking of intestine, upon the agglutination of the bowel loops, or upon intestinal paralysis.

The three forms of tuberculous peritonitis.—In order that a fair idea may be obtained of the result of surgical treatment under the manifold conditions which tuberculous peritonitis presents, Aldibert classifies the disease under three headings :—

(1) The ascitic form ; (2) the fibrous form ; (3) the ulcerous form.

1. **The ascitic form.**—(a) When acute and involving the whole peritoneal surface the condition is that of acute miliary tuberculosis. More usually the tuberculous process, although in no way limited within the abdomen, is either (b) sub-acute or (c) chronic. In such cases very numerous grey granulations, which tend to become confluent, are found all over the inflamed serous membrane. There is abundant ascites. The fluid is citron-coloured, sometimes blood-stained, and rarely sero-purulent. No adhesions are discovered, or if any be present they are scanty and insignificant. Lastly, the peritonitis may be (d) chronic and encysted, the morbid appearances being the same, but the trouble being limited by adhesions.

In general terms it may be said that the *clinical features* in the ascitic form are marked by malaise, fever, headache, wasting, vomiting, and constipation. There is meteorism of the abdomen, which is tender and presents evidences of ascites.

2. **The fibrous form.**—In this variety of the trouble it is apparent that the tuberculous process is moving in the direction of recovery. There are a considerable development of fibrous tissue and evidences of an inflammation of a robust type. Ascites, if present, is always slight. The fluid is clear and very rarely sero-purulent.

Two varieties of the fibrous form may be recognised : (a) The dry variety.—Here tubercles are found disseminated over the whole serous membrane, without ascites, and without adhesions. The tubercles are large, and are, by their size, distinguished from the nodules of acute miliary tuberculosis. This variety is supposed to represent a particular stage in the progress towards recovery. It is met with just after the absorption of the ascitic fluid—which absorption is a feature in the cases which are ending well—and just before the development of adhesions.

(b) The adhesive variety.—This is marked by adhesions, which may be general and extensive. The coils of intestine may be matted together by firm bands, or a mass of adhesions may spread over the whole of the abdominal contents.

In its *clinical aspect* the fibrous form is associated with a sub-acute and insidious onset, with moderate fever, no great impairment of health, the absence of marked vomiting, and constipation alternating with diarrhœa.

It may end in recovery, or pass on to the ulcerous form.

3. The ulcerous form.—This form is associated with caseation and the breaking down of the tuberculous products. Three varieties are described. (a) In the dry variety, when the abdomen is opened, there are presented a confused medley of intestines matted together and to the parietes, and a serous membrane covered with yellowish or grey adhesions, thick, and infiltrated with caseous deposits in one place, and still unchanged tubercle in another. The whole of the intestines may be buried in one fibro-caseous mass. When the adhesions and the attached coils are separated, innumerable loculi are made evident. Some contain clear fluid, some caseous material, some a chocolate-like matter, and a few may contain pus. The adhesions are of every possible variety, disposition, and density. Here and there two adherent coils of bowel may communicate by a fistulous opening, or there may be a fistula discharging fœces at the navel.

The suppurative variety exhibits precisely the same general changes as the dry form, but there is in addition more or less abundant suppuration which may be (b) generalised or (c) encysted.

The *clinical aspect* of the ulcerous form is represented by patients who are wasted and miserable-looking, who have probably been long ill, who exhibit a considerable degree of fever, especially at night, who are feeble and the subjects of profuse sweating, together with vomiting and diarrhœa. The belly is large and there are areas of dulness and of resonance, with hard masses in some parts and fluctuation in others.

The treatment by operation. 1. **The ascitic form.**—It is needless to say that operation is contra-indicated in cases in which general acute miliary tuberculosis exists. It has also proved to be of no avail in examples of acute miliary tuberculosis limited to the peritoneum. In the subacute and chronic forms operation has been attended with good results.

In the cases of this form treated by operation the actual mortality of the laparotomy has been about 3 per cent., and the number of complete cures equal to 35 per cent.

The best effects have followed in the chronic cases, and especially in those in which the peritonitis was encysted. The existence of fever is no bar to operation, and it has not been shown that the laparotomy has caused the tuberculous process to become more diffused about the body. It has been estimated that in the medical treatment of the ascitic forms 9.5 per cent. are cured, 19 per cent. die, and 71.5 per cent. remain unimproved.

With regard to the method of operating, repeated puncture is of no avail in the great majority of instances. It is uncertain, imperfect, may lead to hæmorrhage, and has led to fatal wound of the gut.

In the cases of generalised peritonitis the best results have followed simple incision, without either flushing or drainage.

Drainage is not necessary, and indeed drainage of the whole cavity is impossible. *Fistulæ* have been somewhat common after the use of the rubber tube.

In the encysted form it is desirable that the localised collection should be cut into directly. Irrigation is not called for, and those cases have done best in which no drain was employed.

2. **The fibrous form.**—In the dry variety operation has not been advised by many, as it is assumed that the case is progressing towards cure. Aldibert, however, urges it. He points out that the laparotomy can do no harm, and that the case, if left alone, may relapse, or pass on to the ulcerous form.

In the adhesive variety operation is seldom called for. The condition is one moving in the direction of cure, and it is the opinion of most surgeons that this form of tuberculous peritonitis may be left to medical measures.

Laparotomy may be carried out if there be much fever, if the health be failing, if suppuration be suspected, or if there be much pain or any symptoms of intestinal obstruction.

The operation is rendered very difficult by reason of the adhesions, which should be handled with the greatest care. The best results have attended incision and irrigation without drainage. If many adhesions be broken down then a drain is called for.

Several cases of *fecal fistula* have been noted in connection with operations upon this variety of peritonitis. The percentage of complete cures after operation is over 40 per cent.

3. **The ulcerous form.**—The operation is considered by most to be contra-indicated in the dry form, and in those examples of the encysted form in which the pus is pent up in numerous loculi. The complete evacuation of all these collections involves a serious and widespread operation.

In all other forms of the trouble laparotomy followed by drainage is distinctly to be advised. In the majority of instances recorded the diseased serous cavity has been treated by irrigation.

In these cases the less the adhesions are disturbed the better.

About 20 per cent. of the cases operated upon have ended in complete cure. The actual risk of the operation itself is slight.

Among 308 reported cases of tuberculous peritonitis of all forms treated by laparotomy the mortality from the operation itself has been under 3 per cent.

PERITYPHLITIS.

Definition.—By perityphlitis is understood a localised peritonitis in the vicinity of the cæcum. This usually depends upon some mischief in the vermiform appendix (*appendicitis*). Occasionally, but rarely, it has its starting-point in the cæcum itself (*typhlitis*).

Morbid anatomy.—In a very small minority of the cases the trouble starts in the cæcum, the appendix being entirely unaffected. This variety of perityphlitis has been placed beyond doubt. In most of these rare instances there is a *stercoral ulcer* of the cæcum caused by the pressure and chemical irritation produced by an impacted mass of feces or of undigested food. This ulcer need not penetrate, but it serves to permit bacteria to reach the peritoneum from the bowel and so produce peritonitis. When a perityphlitic abscess is found in association with a hole in the cæcum that hole is usually produced by the pus acting upon the bowel from without. In some examples of genuine typhlitis the wall of the gut is found to be infiltrated and inflamed, but to present neither ulcer nor perforation. Foreign bodies, such as pins and fish bones, have caused a few cases of typhlitis.

I have seen definite perityphlitis of a chronic type follow upon a primary tuberculous ulcer of the cæcum, and have met with a like condition due to epithelioma of that bowel.

I have known epithelioma in this situation make itself first evident by producing perityphlitis, followed by abscess.

Disease of the *appendix* is very common. Indeed, morbid changes in that structure are met with in nearly 20 per cent. of all bodies examined *post mortem*.

In cases of perityphlitis this little structure may be found (1) to have become twisted. This is probably due to the natural shortness of its mesentery, while the actual kinking or volvulus may be brought about by distension of the cæcum. As a result of this torsion the blood supply of the part is interfered with. The organ may become inflamed and thereby greatly enlarged, turgid, and infiltrated. It may become the seat of catarrh. If this be long continued the copious mucous discharge produced may lead to the formation of a *calcareous concretion*, which may have for its nucleus a minute foreign body, and be increased in size by deposits of faecal matter. These calcareous concretions are formed in the same way as rhinoliths.

Ulceration may result, and this may or may not lead to

perforation. The torsion of the little process may end in occlusion of its lumen, and as a result the distal part of the tube may become enormously distended by mucus or muco-pus, and may give way. Stricture may form in the tube as a result of ulceration, and in some cases two or more strictures are discovered. In certain acute cases gangrene may result from torsion, and may involve the whole or a part of the appendix. (2) In the second place the mischief in the appendix may be due to a foreign body, such as a pin, a grape pip, a small shot, a piece of bone, and the like. Most of the so-called cherry-stones and date-stones found in the appendix are calcareous concretions mixed with fæcal matter. (3) In a few rare examples the appendix has been strangulated in one of the fossæ about the cæcum, or in an inguinal or femoral hernia. (4) The appendix may be bent upon itself by the action of contracting adhesions and may become thereby occluded: or it may be so adherent to movable organs as to be constantly dragged upon. (5) The veins of the appendix may be thrombosed, or the little tube may be the seat of tuberculous disease, of epithelioma, or of actinomycosis.

The tendency of these various troubles in the appendix is to destroy and obliterate the process.

The peritonitis produced may end in resolution, may lead to the production of numerous dense and complex adhesions, or may terminate in suppuration.

For details of the abscess *see* page 626.

Causes.—The apparent exciting causes of perityphlitic are numerous. Among the most common may be mentioned dyspepsia, the want of efficient masticating teeth, the bolting of food, the eating of indigestible food such as nuts, constipation, diarrhœa, injury to the groin region, excessive exertion, and exposure to cold.

In the above paragraphs allusion has been already made to tuberculosis, actinomycosis, epithelioma, and foreign bodies as causes of perityphlitic.

This form of peritonitis has been also produced by an extension of the ulcerative process in typhoid fever and dysentery. At least examples of this occurrence have been reported.

Perityphlitic is more common in males than in females in the proportion of three to one, and is most frequently met with in young adults. The greater number of the cases occur between fifteen and thirty.

Bacteriology of perityphlitic.—The micro-organism which is found in the effusion in or around the appendix in this affection is in nearly all the cases examined the bacterium coli commune. (*See* p. 40, Vol. I., and *ante*, page 608.) It is commonly the only micro-organism found, and when associated with others is nearly always the predominant one.

The streptococcus has been discovered in several instances; the pneumococcus in a few, and the staphylococcus in still rarer examples.

Symptoms.—The symptoms of perityphlitic are subject to

considerable variation in degree rather than in general characters. Broadly considered, the clinical phenomena are simply those of local peritonitis. In what may be considered a *typical case* the attack comes on suddenly, and may appear after marked constipation, or some digestive disturbances, or some error in diet. The patient is seized with acute and violent pain in the abdomen—usually about the umbilicus (superior mesenteric plexus). This pain is continuous with exacerbations. It tends to radiate to the back and thighs, and possibly to the testicle. In a little while it becomes more definitely localised in the right iliac region. There is more or less collapse, but not often a rigor. There is nausea and vomiting. The vomiting is not profuse. The bowels cease to act. There is thirst, and absolute loss of appetite. The tongue is at first coated, and then dry. There is fever, the temperature ranging from 99° to 102° or 103°. The urine is scanty.

The abdomen becomes swollen, tense, and tender; the tenderness is chiefly in the right iliac region, and may be intense. Dulness appears in that region, and slowly increases. A swelling can often be made out there; its limits are ill-defined, and its size varies. It has the character of a deeply-placed inflammatory swelling. In children it can often be reached per rectum.

The attack, in an acute form, lasts for six or seven days, and then slowly passes away. In three weeks the patient is about again.

There are many deviations from this type.

The attack may be quite trifling and only confine the patient to the house for twenty-four or forty-eight hours; some attacks do not lay the patient up at all. On the other hand, the onset may be very intense, the phenomena are those of perforative peritonitis, there is marked collapse, and the patient may die in thirty-six or forty-eight hours.

Or the symptoms may be without great acuteness at first, but be greatly extended in duration. The symptoms above noted, and especially the fever, persist—with some alternations in intensity—for three or more weeks, and there follows a tedious convalescence, which may extend over two or more months. Suppuration need not occur in these cases.

In a certain proportion of cases of perityphlitis—but only in the minority—the symptoms advance to suppuration. The signs of deep-seated pus in the iliac region are present. The abscess, if left to itself, extends. If it bursts spontaneously it will most usually open upon the surface of the skin, next in frequency it breaks into the cæcum; comparatively rarely does it burst into the general peritoneal cavity, and still more rarely into the rectum or bladder.

The abscess is usually localised; the suppuration may, however, be diffused. Pus may ascend along the ascending colon, and even enter the thorax.

The pus is occasionally laudable. It is in most cases, however, most offensive, and possessed of that faculent smell which is

commonly associated with the bacterium coli commune. It may contain faecal matter when a perforation exists.

Perityphlitis is prone to relapse—*relapsing typhlitis*. This tendency is met with in at least 30 per cent. of all cases. Some patients have had as many as twenty or thirty attacks. Five or ten attacks are not uncommon. In some of these instances the appendix can be felt during the quiescent period as a hard finger-like swelling, deep down in the iliac fossa, and most commonly about $1\frac{1}{2}$ in. to the inner side of the anterior superior iliac spine. When the appendix is very distinct and very tender, and when the patient feels that he is never entirely free from discomfort about the caecum, it is probable that the little process contains pus.

Diagnosis.—The very acute cases have been often mistaken for perforation of the intestine, or for acute intestinal strangulation. The less acute cases may at the outset resemble renal or biliary colic. In cases associated with diarrhoea the diagnosis of typhoid fever has been made. In examples in children attended with marked tenesmus and the passage of mucus from the bowel, the condition has not unreasonably been confused with intussusception.

Course and prognosis.—The majority of the subjects of this affection recover. The general mortality of the disease in all its aspects has been estimated at 11 per cent. If an abscess form the mortality is raised to between 30 and 40 per cent.

Some of the most acute cases end fatally in forty-eight hours. In 68 per cent. of the fatal cases death occurs within eight days. An ordinary attack lasts from seven to twenty days.

Perityphlitis may end in complete resolution, in recovery with adhesions, or in suppuration.

Relapses are common. In some instances death has occurred from pylophlebitis and multiple abscesses of the liver. In the great majority of fatal instances death is due to septic peritonitis.

Treatment.—The **general treatment** may be very briefly indicated as follows:—Rest in the recumbent position, morphia to relieve pain, warm fomentations to the abdomen, the immediate administration of an enema, and as little food as possible by the mouth.

The application of four or five leeches over the right iliac region often has a magical effect. An aperient should not be administered until after the very urgent symptoms have subsided. Later, the bowels must be made to act regularly. The diet throughout must be simple and spare.

Operative measures.—The great majority of the cases of perityphlitis call for no operative treatment. In the ultra-acute cases it is well that the abdomen be opened at once in the caecal region, and the case considered and dealt with as one of perforative peritonitis. Such cases are very uncommon. When the evidences of abscess are present an incision should be made into the collection as soon as possible. The cut should be made over the most prominent part of the swelling. A convenient situation for the incision

in most cases (and in all doubtful cases) is represented by a point about $1\frac{1}{2}$ in. to the inner side of the anterior superior iliac spine. This incision should be about parallel to Poupart's ligament.

The abscess should be opened and drained. It should not be scraped and it is of no avail to make search for the appendix. To excise an appendix by a plastic operation when it is situated at the bottom of a foul abscess is not in conformity with surgical principles. A gangrenous appendix, if met with, may be snipped off, and if a perforated appendix actually presents itself it may be ligatured and cut away. As a matter of fact, after an abscess has once formed, very little more is heard of the appendix. These abscesses are apt to degenerate into fistulæ and sometimes into fæcal fistulæ. They exhibit, however, a strong tendency to close spontaneously in time.

An incision in perityphlitis is very seldom called for before the fifth day.

The wound made is not infrequently followed by a ventral hernia.

The use of exploring needles in perityphlitis is to be strongly condemned, and the same may be said of reckless and unnecessary incisions made without due cause during the first two or three days of the attack.

In cases of relapsing perityphlitis much may be done to ward off another attack by attention to the diet, to the bowels, and to the general mode of living of the patient. A plate of false teeth has cured more than one case of relapsing perityphlitis.

Considerable benefit attends the use of such an intestinal antiseptic as salol, given in a powder night and morning in doses of ten grains.

Failing these measures, the appendix should be removed during a period of quiescence.

The cases most distinctly suited for this measure are the following:—

(1) Cases in which the attacks, although slight, have been numerous and at short intervals.

(2) Cases in which the last attack has been of intense proportions.

(3) Cases in which the appendix can still be felt as a swollen and tender structure and is the seat of frequent attacks of pain.

The operation is sometimes most simple, and is sometimes exceedingly difficult by reason of adhesions.

The mortality of the procedure may be placed at 2 per cent. In my own practice it has been below that.

INTESTINAL OBSTRUCTION.

Under this term are included those very numerous and varied conditions in which the contents of the intestinal canal are obstructed in their normal progress. It is assumed that the obstruction is a mechanical one as distinguished from such an arrest of intestinal movement as is associated with peritonitis and certain neuroses.

Obstruction due to some protrusions of the bowel are considered under the title of *Hernia*. (See page 664.)

The varieties of intestinal obstruction.—The classification of intestinal obstruction is most conveniently founded upon the basis of morbid anatomy, and may be tabulated as follows:—(1) Strangulation by bands and through apertures, (2) volvulus, (3) intussusception, (4) stricture, (5) obstruction by tumours and foreign substances within the bowel, (6) obstruction by the pressure of tumours, etc., external to the bowel, (7) faecal accumulation.

Relative frequency of the various forms.—Among 1,000 fatal cases of intestinal obstruction the above-mentioned varieties are roughly distributed as follows:—Intussusception, 350; strangulation by bands and through apertures, 250; stricture, 150; obstruction by tumours and foreign bodies within the bowel, 100; faecal accumulation, 60; volvulus, 50; obstruction by means of tumours, etc., external to the bowel, 40; total, 1,000.

This order of frequency is somewhat misleading, inasmuch as it is based only upon such cases as end fatally. In actual practice the cases due to faecal accumulation are the most common, and those due to foreign bodies and to the pressure of tumours, etc., external to the gut are of greater relative frequency than the above list would appear to prove.

An examination of the records of the London Hospital shows that the cases due to faecal accumulation are the most numerous; then come cases of stricture of the large intestine, then intussusception, and then strangulation by bands. Obstruction due to tumours external to the bowel ranks next, and other forms may be spoken of as rare.

Portion of bowel involved.—Strangulation by bands most commonly involves the small intestine. Volvulus is most frequent in the sigmoid flexure, and intussusception in the ileo-caecal segment of the bowel. Strictures of all kinds are more common in the colon than in the lesser intestine. Obstruction due to pressure from without may be met with in any part of the canal, but more usually concerns the large intestine as being the less movable, and especially the rectum and sigmoid flexure from their position. Foreign bodies often lodge in the lower ileum and in the caecum, and gall stones are apt to become impacted in the jejunum or upper ileum. Faecal accumulation of necessity is met with in the colon, and often in the caecum and sigmoid flexure.

Sex and age.—*Strangulation by bands and through apertures* is a little more common in males than in females, is met with mostly in young adults, and is rare after forty. *Volvulus of the sigmoid flexure* is about four times more common in men than in women. It is most common between forty and sixty, and is indeed rare before forty. *Acute intussusception* is a little more common in the male sex. It mostly attacks the young. Fifty per cent. of the cases are under the age of ten years. *Strictures* are equally common in the two sexes. The non-malignant occur about early middle life.

The cancerous stricture is rare before forty. *Obstruction due to tumours* is obviously more common in women and in adults of that sex. *Obstruction due to impacted gall stones* is more common in females than in males, and the average age falls between fifty and sixty-five. *Fæcal accumulation* occurs with greater frequency in women than in men. It is most common in adults and in the aged, and is—as may be imagined—not infrequent in the insane and hysterical.

Morbid anatomy of intestinal obstruction. 1. Strangulation by bands or through apertures.—Under this heading

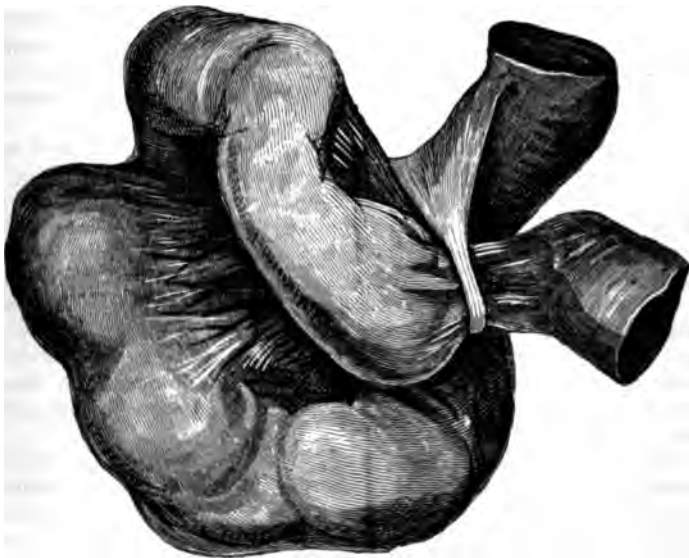


Fig. 775.—Strangulation of Small Intestine by a Band from the Mesentery. (From Treves's "Intestinal Obstruction.")

a great many different anatomical forms of intestinal obstruction are included. They all, however, have this common character—a loop of intestine, which may vary in length from a mere knuckle to many feet—is ensnared beneath an unyielding band, or compressed by the margin of some normal or abnormal aperture, and is thereby strangulated. The nature and effects of the lesion are precisely comparable to those which occur in strangulated hernia. Indeed, under the present heading are often grouped those forms of obstruction known as "internal herniæ." (See page 656.)

The obstructing agents may be arranged in five divisions:—

(1) The bowel is strangulated by a *peritoneal false ligament*. These so-called ligaments are isolated adhesions, the result of peritonitis. The peritonitis in question is commonly that of perityphlitis, or it may have been associated with pelvic cellulitis

(so-called), or with injury or strangulated hernia, or may have been of tuberculous origin. Adhesions capable of producing strangulation may, indeed, follow any form of peritonitis from which recovery has occurred. Many of the adhesions formed during the progress of peritonitis no doubt disappear. Others persist, and a few are apt to become elongated from traction, and cord-like from the constant moulding action of the ever-moving intestines. The obstructing band may be single, or it may be one of many. It is usually narrow, slender, and cord-like (Fig. 775). Its length and attachments must necessarily vary. In most instances the adhesion is found to be stretched in front of a resisting surface, such as the posterior abdominal wall, the iliac fossa, or a surface of the mesentery. The adhesion may, on the other hand, be wide and membranous. The bowel is commonly strangulated beneath the band. In rare instances a cord-like band appears to have formed a noose or loop, by which the gut has been ensnared.

(2) *Omental cords* may cause strangulation. A portion of the free border of the great omentum may become adherent at some spot (commonly a hernial orifice, or near to a once-inflamed vermiform appendix), and the part so held may become changed into a cord-like structure. Sometimes the adherent part of the omentum is quite separated from the rest of the epiploön, or the whole mass of the omentum may be found rolled up into a fan-shaped structure, the base of the fan being at the transverse colon.

(3) *Meckel's diverticulum* is due to the persistence or incomplete obliteration of the vitelline duct, and when present comes off from the ileum from 1 to 3 feet from the cæcum. In its most complete condition it appears as a tube passing from the ileum to the umbilicus. More often it takes the form of a short diverticulum hanging from the ileum. Indeed, the average length of the diverticle is 3 inches. The process may be free or attached at its distal extremity. It may be partly tubular and partly cord-like, or it may be found to be wholly in the condition of a cord. Such a cord may represent a greatly atrophied and imperfect diverticulum, or may be the remains of the omphalo-mesenteric vessels. The "solitary band" of older authors was probably of this nature, although in some cases it may have been a well-isolated and much-lengthened peritoneal adhesion. The abnormal process may form an arcade, beneath which a loop of gut may be strangulated, or it may snare the bowel or form a noose around it.

(4) The strangulating agent may be a *normal structure which has become abnormally attached*. Thus intestine has been found strangulated beneath an adherent vermiform appendix or Fallopian tube, and beneath a fixed portion of the mesentery or the pedicle of an ovarian cyst.

(5) The gut may be strangulated through some *slit or aperture*. Most often the slit is found in the lower part of the mesentery, and may be due to injury or be congenital.

Like slits have been found in the omentum. Bowel has been

strangulated by the margins of a slit in the broad ligament of the uterus, in the suspensory ligament of the liver and in the sustentaculum lienis, by the ring sometimes formed by adherent intestinal

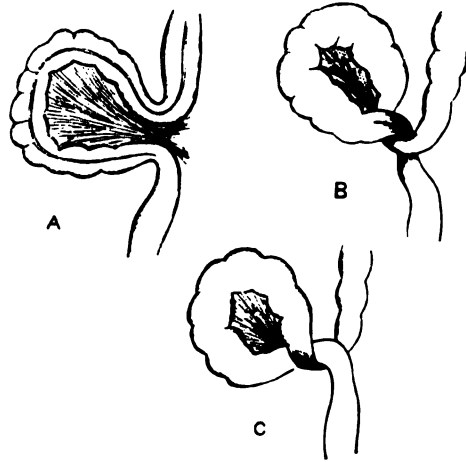


Fig. 776.—Volvulus of the Sigmoid Flexure. (From Treves's "Intestinal Obstruction.")

loops, by the slit left between two parallel bands of adhesions, and through apertures even more remarkable.

Internal hernie present some features which would make it convenient that they should be considered with the present variety of

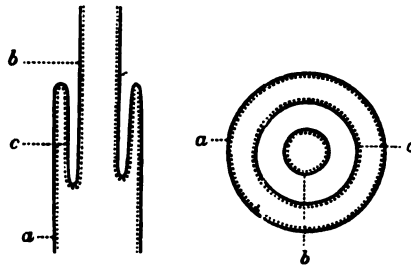


Fig. 777.—Vertical and Transverse Sections of an Intussusception. (From Treves's "Intestinal Obstruction.")

a, The sheath or intussusciens; b, the entering or inner layer; c, the returning or middle layer. The dotted line indicates mucous membrane.

intestinal obstruction—but the peculiarities of these internal "ruptures" are such that it is desirable that they should be considered in a separate section. The subject is dealt with on page 656.

2. **Volvulus.**—The term is applied to a condition where the intestine is so twisted that its lumen has become entirely occluded. Volvulus may concern the small intestine, the ascending colon and

cæcum, or the sigmoid flexure. It is only commonly met with in the *sigmoid flexure*. When the sigmoid flexure is involved the bowel is found to be twisted (usually from left to right) around its meso-colic axis (Fig. 776, b). The twist may be in the opposite direction (Fig. 776, c). Both ends of the loop are occluded. The sigmoid flexure, to become the seat of a twist, must be of good length, and must have such a disposition of the meso-colon as will bring the two ends of the loop near together (Fig. 776, a).

The distension which takes place in the bowel after it has become twisted is often enormous. In some cases the involved coil has appeared to occupy almost the whole abdominal cavity. As the twisted loop becomes distended it moves towards the right hypochondriac region. The bowel becomes intensely congested, and in the condition, indeed, of the gut in strangulated hernia.

Patches of gangrene soon appear, and peritonitis is very common. It is usually impossible—even on the post-mortem table—to overcome the volvulus until the bowel has been emptied of its gas.

When the *cæcum* and *ascending colon* are together provided with an extensive meso-colon (a not very uncommon congenital condition) this large and quite free loop of bowel may become twisted about its meso-colic axis.

A loop of the *small intestine* may be found twisted about its own mesenteric axis. It is a question whether this can ever concern a normal bowel. As a rule, in this very rare accident the two ends



Fig. 778.—Ileo-colic Intussusception. (From Treves's "Intestinal Obstruction.")

A, Ascending colon; B, ileum; C, vermiform appendix.

of a large loop of the lesser bowel have been drawn together by peritoneal adhesions of some kind, and so a kind of pedicle has been produced, about which a twisting is possible.



Fig. 779.—Ileo-caecal Intussusception, with great swelling of the Intussusceptum.
(From Treves's "Intestinal Obstruction.")

3. Intussusception.—By this term is understood the prolapse or turning of one part of the wall of the bowel into the lumen of an immediately adjoining part. When an intussusception is viewed in vertical section (Fig. 777) it is found to be composed of six layers of intestine—three on each side of the central canal—all more or less parallel to one another. On transverse section it shows three concentric rings of bowel (Fig. 777). In whatever way the section be made, mucous membrane is always found in contact with mucous membrane, and peritoneum with peritoneum. The external of the three layers is known as the *intussuscipiens* or sheath. The innermost cylinder is called the entering layer, and the middle one the returning layer. These two layers taken together form the *intussusceptum*.

There are four varieties of intussusception:—
(1) Enteric, (2) colic, (3) ileo-caecal, (4) ileo-colic.
The *enteric* involves the small intestine and es-

pecially the lower jejunum and ileum. It is usually quite short. The *colic* may be found in any part of the colon, but is most common in the descending colon and sigmoid flexure. It also seldom attains great length. In the *ileo-caecal* invagination the ileum and caecum pass into the colon preceded by the ileo-caecal

valve, which forms the apex or free extremity of the intussusceptum (Fig. 779). This form may attain great size so that the valve may reach the anus and project beyond it. In the *ileo-colic* form the end of the ileum is prolapsed through the ileo-cæcal valve. The valve and the cæcum remain, for a while at least, unmoved, and the prolapsed ileum always forms the apex of the intussusception (Fig. 778).

Out of one hundred cases of intussusception about forty-four will be ileo-cæcal, thirty will be enteric, eighteen colic, and eight ileo-colic.

In all forms of intussusception, except the ileo-colic, the invagination *increases* at the expense of the external layer only. Thus, supposing the end of the jejunum to be invaginated into the ileum, if the mass increase it will do so solely at the expense of the ileum, and no more jejunum will actively enter the intussusception. It thus happens that the apex of the intussusception always remains the same, no matter to what length the invagination attains.

In the ileo-colic form the end of the ileum is prolapsed through the valve, and as the invagination increases more and more ileum is protruded through the ileo-cæcal opening while the sheath remains unchanged. When, for various reasons, no more ileum can become invaginated, then, if the tumour increase, the cæcum will be turned in, and after it the ascending colon, the intussusception now growing solely at the expense of the external layer or sheath.

The true or obstructive intussusception must be distinguished from a form of invagination which is supposed to be due to disordered intestinal movements occurring during the act of dying. These *intussusceptions of the dying* are always small, are most common in the small intestine, are usually multiple, are frequently ascending or retrograde, and are always easily reduced. They produce no symptoms. The true intussusception is always descending, *i.e.* always moves in the direction of the intestinal contents, and is practically always single.

The *tumour* formed by the intussusception has a somewhat curved outline. This is due to traction on the mesentery carried in with the invaginated gut. The tumour will therefore be concave on the side to which the mesentery is attached. The traction of the mesentery tends to pull the aperture of the intussusceptum towards the mesenteric side of the sheath.

At a variable time after the invagination has formed, the intussusception tends to become engorged with blood and greatly swollen. From this engorgement, coupled with the constriction to which the neck of the intussusceptum is subjected, the inner and middle layers may soon be found in the condition of strangulated bowel. The lumen of the gut becomes gradually narrowed and may in time become quite occluded.

The occlusion is due mainly to the great swelling of the intussusceptum and also to the curving of the tumour, and occasionally to plugging of the canal with blood-clot.

Another important change is this: the intussusception is apt to

become irreducible. This may depend upon adhesions at the neck or between the opposed serous surfaces of the inner and middle layers, or it may be due to the great swelling of the intussusceptum, or to its great curving, or to the presence of some polyp, or in the case of the ileo-colic form to the resistance offered by the ileo-cæcal valve.

The intussusciptiens seldom undergoes gross change. It may, however, become the seat of some local peritonitis, or become ulcerated, or even in rare cases gangrenous.

The intussusceptum tends to become gangrenous. The gangrene is produced by the same conditions which foster it in strangulated

hernia. The necrotic process may be quite limited in extent, or, on the other hand, the whole of the intussusceptum may perish *en masse* and be discharged by the anus. Several feet of bowel have been evacuated in this way. It is by means of gangrene of the intussusceptum that an invagination may undergo spontaneous cure. Many cases of recovery after separation of large parts of the bowel are on record, but this method of recovery is rare, uncertain, and desperate. Speaking generally, the least acute form of intussusception is the colic variety, then, probably, the enteric, then the ileo-cæcal, and, lastly, the ileo-colic,



Fig. 780.—Epithelioma of the Colon. Bird's-eye view of the interior of the bowel. (from Treves's "Intestinal Obstruction.")

At A a triangular piece of the intestine has been cut away.

which nearly always runs an acute and rapid course.

The course of an intussusception may be chronic. In a *chronic intussusception* the parts will be found to be greatly thickened and to be more or less congested. The thickening mainly concerns the intussusceptum, and it is common to find that part of the invagination ulcerated. The chronic intussusception is usually reducible in part; a certain portion, however, remaining permanently irreducible.

4. Stricture of the intestine.—All cases of stricture may be divided into two classes, the cicatricial and the malignant. The *cicatricial stricture* may result from dysenteric, syphilitic, or tuberculous ulceration, the first-named being a common cause of this stenosis.

The dysenteric ulcers are most common in the lower part of the colon, the syphilitic in the rectum, and the tuberculous in the vicinity of the ileo-cæcal valve. Rarer instances of stricture have been due to ulceration produced by impacted faeces or foreign bodies, to lesions

following strangulation of the bowel in a hernia, the separation of a gangrenous intussusception, or to the effects of direct injury of the bowel. Certain strictures are congenital.

The *malignant stricture* is due to the growth in the bowel of a cylindrical epithelioma—the only primary form of cancer to which the intestine would appear to be liable.

Epithelioma produces very well-defined, tough ring-like strictures of the bowel (Fig. 780). The outer surface of the gut at the seat of stricture is often very sharply constricted, as if a cord had been tied around it. In the interior of the bowel the growth assumes an annular outline. The indurated mass is ulcerated, and the ulcer has usually a sharply thickened, raised, and everted edge, which is quite typical.

Malignant strictures are much more common than cicatricial strictures, and the colon is much more frequently the seat of stenosis than is the small intestine. Excluding the rectum, the commonest seat of stricture of the bowel is in the sigmoid flexure; next in frequency comes the descending colon; and then, in order, the splenic and hepatic flexures. In not a few instances the stricture has involved the ileo-cæcal valve.

5. Obstruction by tumours and foreign substances within the bowel.—The following tumours are met with in the intestine:—Fibroma, fibro-myoma, lipoma, angioma, sarcoma, lympho-sarcoma in connection with Hodgkin's disease, and adenoma. The adenoma is the most common growth. Many cases of lympho-sarcoma have been recorded, but all the other tumours are quite rare and unimportant. The adenoma grows from the mucous membrane, and is composed of glandular tissue of the type found in Lieberkühn's follicles. These tumours nearly always assume a polypoid outline. When the supporting connective-tissue of the mass is loose and lax it is called a *soft polyp*; when it is more dense and fibrous the tumour is called a *firm* or *fibrous polyp*. Adenomata are more frequent in the rectum and colon, are most often met with in children, and are more usually multiple than single. After the colon, the lower ileum is the most frequent seat of polypoid growths. Sometimes these growths may attain great size. They may cause obstruction by their bulk or by their numbers, and they not infrequently lead to intussusception. Sometimes the polyp bleeds very freely. The pedicle of a polyp has given way and the mass been discharged per anum.

The *foreign bodies* which have been impacted in or have passed through the intestinal canal are of infinite variety. The victims are very often children, or hysterical patients, or lunatics.

Those substances which are smooth and rounded—such as pebbles, coins, etc.—may pass readily through the bowel, while irregular-shaped bodies—such as pieces of bone and porcelain, nails, spoons, and plates carrying false teeth—are apt to lodge at some part of their course. It is remarkable that the great majority of the foreign bodies swallowed, in spite often of their size and outline, are passed in due

course by the anus. They may be retained for weeks, and even months, and then be evacuated. The body, if impacted, is likely to lodge in the lower ileum or cæcum. It may there excite ulceration of the bowel. This may lead to perforation and death, or may induce the formation of an abscess, upon the evacuation of which the foreign substance is safely discharged (Fig. 781). Bodies which have been swallowed have passed by ulceration from the small intestine into the colon, or even into the bladder.

Gall stones have often led to fatal obstruction. The stone to cause obstruction must be of great size, and it is probable that in



Fig. 781.—Passage of an Iron Teaspoon (which had been swallowed five weeks previously) from the Colon through the Abdominal Parietes. (Case by Mr. Rouse, *Lancet*, Sept. 9, 1893.)

every instance the calculus has reached the bowel by direct ulceration between the gall bladder and the duodenum. If the stone be able to pass the bile duct it will certainly be able to pass through the intestine. When impaction takes place, the stone is usually found to be lodged in the lower ileum, and, next in frequency, in the duodenum or jejunum. Impacted gall stones have induced fatal ulceration and gangrene of the bowel, and have led to *fecal abscesses*, through which they have been discharged.

Biliary calculi may be retained for weeks or months without causing any symptoms; or after severe symptoms of obstruction have been produced they may be spontaneously evacuated.

Obstruction in the bowel may be produced by *intestinal calculi* or *enteroliths*. Some of these concretions are largely composed of phosphatic deposits, which are usually found to be formed around a nucleus composed of some undigested substance. Such enteroliths are stone-like, are usually single, and of small size.

They may be found in the appendix and, like the rhinoliths in the nasal cavities, are probably due to long-continued catarrh.

Other enteroliths are of low specific gravity, are porous and sponge-like, and are composed of densely-felted masses of vegetable fragments mixed with calcareous and fæcal particles.

To this class belongs the avenolith or oat stone, which is said to be met with in the intestines of those who live largely on oatmeal. Other of these calculi are made up of hair and fibres, such as cocoanut fibres, or of some insoluble mineral matter—such as magnesia—swallowed as medicine (Fig. 782). These may attain



Fig. 782.—Obstruction of the Small Intestine by a Concretion of Magnesia. The wall of the bowel has been cut away in two places to show the concretion.
(From Treves's "Intestinal Obstruction.")

great size. One enterolith was found to be composed solely of gum benzoin. An impacted gall stone has formed the nucleus of a considerable concretion, composed of calcareous and fæcal matters.

6. Obstruction by the pressure of tumours, etc., external to the bowel.—As examples of this form may be cited—occlusion of the gut by a displaced uterus, by uterine or ovarian tumours, by large abscesses, by tumours of the kidney and other parts, by hydatid cysts, cancerous glands, an enlarged spleen, etc.

7. Fæcal accumulation.—The conditions which favour fæcal accumulation are very numerous, and among them may be mentioned—chronic dyspepsia and constipation, the consumption of masses of indigestible food such as nuts, loss of muscular power in the bowel due to age, to weakening diseases, to neglect of the bowels, or to that exhaustion of the gut which may attend the habitual taking

of aperients. Many of the patients are edentulous and cannot masticate their food.

The condition may be encouraged by damage to the bowel from ulceration, such as that of dysentery, by old adhesions, by unusual bends and folds in the colon—especially in the transverse colon—the outcome of long-continued over-distension. In all cases peristaltic movement is feeble and inadequate. The condition once termed “ileus paralyticus” referred to cases in which the bowel became blocked with faecal matter, and in which obstruction symptoms, attended with vomiting and great distension of the belly, ensued. It was assumed—not quite correctly—that the intestine was wholly paralysed. Faecal masses lodged in the colon fill up the sacculi, and tend to become nodular in consequence. They become hard by absorption of their more fluid parts. They are met with most usually in the caecum, or sigmoid flexure, or at the hepatic flexure, or in the transverse colon (Fig. 783). The bowel containing them is apt to become ulcerated, partly from pressure and partly from the chemical irritation of the highly decomposed mass.

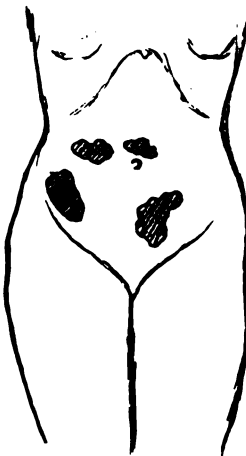


Fig. 783.—Diagram to show the Positions in which Faecal Masses are common.

These ulcers are most common in the caecum, because it is upon that part of the colon that the greatest strain comes in faecal accumulation. They are called “stercoral ulcers,” and may be both numerous and extensive. They are usually superficial, but occasionally lead to perforation. If the colon “gives way” as the result of obstruction, the rent or perforation is usually in the caecum, which, as

just stated, bears in all these cases the major part of the strain.

The bowel above a faecal mass is generally distended, while below it is more or less contracted.

Rarer forms of obstruction.—Among the rarer forms of obstruction which are excluded from the above classification are occlusion of the bowel by *acute bending or kinking* due to traction upon an adhesion, or an adherent diverticulum; occlusion by means of *adhesions* which compress the gut or which mat many coils together, as after tuberculous peritonitis; narrowing of the bowel from *shrinking of the mesentery* after inflammation.

Here also may be mentioned those forms of intestinal obstruction which are of purely nervous origin, and belong to the *neuroses of the intestine*. The subjects are either intensely neurotic, or hysterical, or melancholic, or actually insane. The mimicry of the real disease is often very remarkable. Not only are there pain and constipation, but there is also vomiting, and that vomiting may be

actually *feculent*. These cases are commonly marked by great distension of the belly, or constant rumblings, by the incessant belching of gas (representing to some extent air swallowed by the patient); there is vomiting, but it is uncertain and often slight, and between the attacks the patient may eat fairly well. The patient describes his symptoms with great exaggeration, and is usually in a state of marked depression. I have twice opened the abdomen in apparently hopeless cases of this kind. Nothing abnormal was found, but both patients made a perfect recovery.

Symptoms of intestinal obstruction.—From a clinical point of view cases of intestinal obstruction may be conveniently divided into three classes:—(1) Acute obstruction, (2) chronic obstruction, and (3) cases in which symptoms of acute obstruction supervene on those indicative of chronic obstruction.

1. **Acute intestinal obstruction.**—The patient is seized more or less suddenly with very severe abdominal *pain*. This is generally localised about the umbilicus, and the patient may be “doubled up” by it or roll in anguish on the floor. The pain is of the nature of colic, *i.e.* is a griping pain, and is usually constant although liable to exacerbations. There is at first at least little or no *tenderness* of the abdomen, and the patient indeed often is relieved by pressure upon the belly walls. There is *collapse*, with great depression of strength, pallor, a feeble rapid pulse, a cold sweat over the face, a sighing respiration. *Vomiting* appears early, is first composed of the contents of the stomach, is then bilious, and later brownish and offensive. It is copious and persistent, gives little or no relief, and in time very usually becomes *stercoraceous*. Nothing can be retained in the stomach. There is *constipation*, which is usually absolute from the first. The belly becomes more or less *distended*, and towards the end of the case is apt to become tender. The *tongue* is foully coated, the mouth dry. *Thirst* is intense. The *temperature* is below normal. The *amount of urine* is diminished. If unrelieved, the symptoms persist, the exhaustion increases rapidly, the tongue becomes dry and brown, the face pinched and the eyes sunken. The patient dies with those symptoms of *septic poisoning* which mark the termination of acute peritonitis. There may be delirium, but as a rule the patient retains consciousness until the last. The vomiting usually remains the most distressing symptom.

The majority of the acute cases die, if unrelieved, within six or seven days. The varieties of acute obstruction are enumerated on page 645.

2. **Chronic intestinal obstruction.**—The onset in this form of obstruction is *gradual*, and the progress of the malady irregular. There are attacks of abdominal *pain*, which are not severe, which come on at first at long intervals, are often provoked by food, and are frequently ascribed to indigestion or colic. These attacks become more frequent, more severe, and of longer duration. They are attended with some vomiting and constipation. The *vomiting*

is probably slight, and does not persist. There may, however, remain much nausea and disinclination for food. The *constipation* is not at first absolute. The patient is in the early stages relieved by aperients. These drugs then act with less and less effect, and at last only occasion severe pain and vomiting. Sometimes there is a period marked by *diarrhœa*. This diarrhœa is "spurious." It is due to catarrh excited in the bowel by retained fecal matter above the obstruction, and is only met with when the stenosis is somewhat low down in the colon. Between these attacks the patient may feel fairly well, and suffer only from some abdominal distension, much irregularity of the bowels, nausea, malaise, and loss of appetite.

The *tongue* becomes white and coated, and the breath most offensive. The *temperature* is not disturbed, nor is anything abnormal noted in the *amount of urine* passed. The belly becomes more and more *distended*. A *tumour* is often discovered. *Visible coils of intestine* can be seen in movement through the apparently thinned abdominal parietes. When the movements take place the patient has pain. There are frequent rumbling and *gurgling sounds* in the abdomen, which are very audible to those around. The pain becomes more continuous and more severe, the vomiting is more persistent, the constipation is at last absolute, the distension of the belly increases, and the strength rapidly fails.

Unless some accident, such as perforation, occurs, the patient (if unrelieved) dies exhausted and marasmic, worn out by the continued pain and vomiting, wasted by inability to take food, and poisoned by the absorption of noxious matter from the horribly putrid contents of his own intestine. The breath has often at last a perfectly fecal odour.

The phenomenon termed *ballooning of the rectum* has been said to be a sign of stricture of the colon. On introducing the finger into the anus in a case in which this condition exists the bowel will be found to be empty and the rectum so dilated that the finger can at first scarcely reach the limits of its walls. The precise cause of this curious condition has not yet been defined. It evidently concerns the innervation of the bowel. Ballooning of the rectum is often met with in stricture of the colon. It is, however, not diagnostic. It is not present in every case on the one hand, and, on the other, it may be met with in localised peritonitis and in other conditions.

Death may be said to occur, if the general series of cases of chronic obstruction be considered, in some six months after the onset of the obstruction symptoms. The varieties of chronic obstruction are detailed on page 647.

3. **Chronic intestinal obstruction ending acutely.**—This class of case is not uncommon. The patient has some obstruction in the bowel which does not completely block it. He has the symptoms of chronic obstruction. Upon these are suddenly engrafted the phenomena of acute, or rather subacute, obstruction. This sudden alteration may be due to many causes. There may be a very narrow stricture which has become suddenly blocked by a

mass of undigested food, and thus it is that these acute attacks are very often induced by a brisk aperient.

In other cases the stenosed bowel has been kinked or acutely bent upon itself, and so closed; or it has become the seat of a volvulus, or of an intussusception. In not a few instances attention has been first called to a malignant stricture of the colon by an attack of subacute obstruction, the patient having previously complained only of dyspepsia, constipation, and colic. A case of faecal accumulation may end with acute symptoms.

An analysis of the leading symptoms.—1. **Collapse**, as an early symptom, is seen only in cases of acute obstruction. It is due to the sudden lesion inflicted upon the intestinal and peritoneal nerves. The severity depends upon the suddenness of the strangulation, its rigour, the amount and nature of the gut involved. It is more marked when the small bowel is concerned as compared with the colon. The collapse will obviously be influenced by the age and general condition of the patient. It may in some cases be so profound as to resemble the collapse of cholera. Later in the case the collapse is that of poisoning. The patient in acute cases, and often in chronic, dies poisoned, the septic matter entering the circulation from his own intestine.

2. **Pain**, in the onset of acute cases, depends for its severity upon the suddenness of the strangulation, the amount of bowel involved, and upon other obvious circumstances. The first pain is due to damage to the bowel, later it is the pain of distension and of futile peristalsis, and finally, as a rule, the pain of peritonitis. In acute cases the initial pain is commonly referred to the region of the umbilicus, *i.e.* to the region of the mesenteric and solar plexuses. Later, it is possible that the pain may be definitely localised. When the obstruction is complete the pain is usually continuous, although marked by exacerbations. When the obstruction is incomplete the pain has a distinctly intermittent character.

3. **Vomiting** is a very constant symptom of intestinal obstruction. That which appears at the very commencement of an acute case is no doubt reflex. The vomiting in the after-course of the acute case and in the chronic case depends for the most part upon the obstruction. The bowel above the obstruction becomes distended and peristaltic movements passing along it induce a backward axial current in the contents, whereby they are poured into the stomach.



Fig. 784.—Case of Distension of the Small Intestines about the Median Parts of the Belly, the colon being empty, as shown by the sinking in of the loin.

Stercoraceous vomiting appears earlier in obstruction of the small intestine as compared with the large. An obstruction in the lower ileum may be attended with actually faeculent vomiting. Matter long retained in even the upper ileum may, from decomposition, obtain a stercoraceous odour.

4. **The state of the bowels** will, of necessity, vary greatly. In acute cases the constipation is commonly absolute from the first, and as the obstruction may be high up, and the colon be loaded, it is evident that this paralysis of the bowel is reflex. In Richter's

hernia (page 701), in which the bowel is not entirely occluded, the constipation is commonly absolute. In an acute case, however, a copious natural motion may be passed after the onset of the obstruction symptoms, and be derived from the bowel below the seat of the lesion.

In intussusception there is diarrhoea, or what appears to be diarrhoea.

5. **The state of the abdomen.**—

Visible peristaltic movements and visible coils of intestine indicate a long-abiding partial mechanical obstruction, which has led to hypertrophy of the bowel above it. The meteorism in intestinal obstruction depends partly upon the completeness of the occlusion of the bowel, but more directly upon interference with the circulation through the bowel wall. This has been demonstrated by experiment, and illustrated in man by cases of phlebitis of the mesenteric veins. Meteorism is most marked, and is earliest seen when the colon is obstructed. In no form of intestinal obstruction is meteorism at once more sudden and more severe than in volvulus of the sigmoid

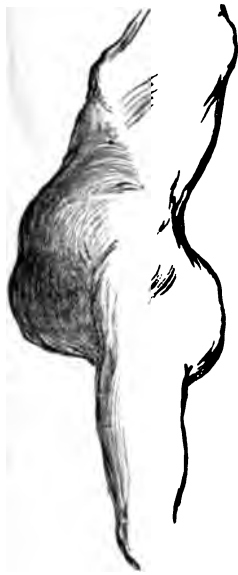


Fig. 785.—Case of Distension of the Colon, especially of the Transverse Colon.

flexure. In occlusions of the upper jejunum the distension of the abdomen will be limited to the region of the stomach. When the small intestines are distended, and the colon empty, the median parts of the belly are protuberant (Fig. 784). When the colon is the part distended, the loins or the regions of the cæcum, sigmoid flexure, or transverse colon, are conspicuous (Fig. 785). Meteorism is not so reduced by vomiting or even by diarrhoea as may be supposed.

An abdominal tumour may be felt in the following cases:—Intussusception, faecal accumulation, cancer, certain neoplasms, and in some cases of obstruction by foreign bodies.

A number of coils of small intestine, matted together by adhesions, have formed a species of tumour, and a localised dulness on percussion has been caused by collapsed coils of the lesser bowel

which have become grouped together below an obstruction. Such empty coils can occasionally be felt by the finger on a rectal examination.

6. The diminished amount of urine passed in many of the acute cases does not depend upon the seat of the obstruction, as once urged, but upon its acuteness and upon the degree of the impression made upon the nervous system. It is rather one of the symptoms of collapse, and varies with the extent of the collapse and the severity of the pain. In these cases a marked increase in the amount of urine passed often attends the administration of a full dose of opium.

Obstruction in the small intestine compared with obstruction in the large.—**Obstruction of the small intestine** (1) most usually takes an acute form; (2) the pain is very intense; (3) vomiting is early, copious, persistent, and apt soon to become—on an average about the fifth day—stercoraceous; (4) meteorism appears comparatively late and is seldom of high grade.

Obstruction of the large intestine (1) most commonly takes a chronic course. (As an exception to this must be mentioned volvulus of the sigmoid flexure.) (2) The pain is not so intense. (3) Vomiting is late to appear, is scanty, may diminish, and is rarely feculent until after a considerable interval. (4) Meteorism appears early, and is apt to be marked. (See the distinguishing features of stenosis of the small and of the large intestine, page 647.)

Differential diagnosis.—A. If the case be *acute* it may most probably be placed under one of the following headings:—(1) Strangulation by bands or through apertures, including strangulation by an adherent appendix and the like. (2) Volvulus of the sigmoid flexure. Other forms of volvulus are rare. (See page 633.) (3) Acute intussusception. (4) Acute obstruction by gall stones, foreign bodies, and enteroliths.

B. If the symptoms be *chronic* the trouble may be due to (1) stricture of the small intestine, including the many conditions in which the lesser bowel has its lumen partly occluded by compression, by bending, by obstructing substances, or new growths. (2) Stricture of the colon, including the many conditions in which the colon has its lumen partly occluded by compression, by bending, by obstructing substances, or new growths. (3) Fæcal accumulations. (4) Chronic intussusception.

C. The obstruction may have been *chronic* in its general course and may then terminate *acutely*.

The cases which would come under this heading have been already alluded to (page 642) and call for no further consideration.

A. The acute cases; distinguishing features. (1) **Strangulation by bands, etc., and through apertures.** *History.*—The patients are mostly young adults. In 68 per cent. of the cases there is a history of previous peritonitis. The onset is sudden. *Pain* appears early, is very severe and persistent, and is mostly located about the umbilicus. *Vomiting* appears early, is

copious, persistent, and severe. In 60 per cent. of the cases it becomes stercoraceous on an average about the fifth day. It gives no relief. *Constipation* is, as a rule, absolute. There is neither *tenesmus* nor a discharge of blood by the anus. *Meteorism* is seldom marked before the third day. The abdominal wall is not rigid. No tumour or dull area is to be detected.

Leading features.—The symptoms are those of an acutely-strangulated hernia.

2. Volvulus of the sigmoid flexure. *History.*—The patients are mostly adults between forty and sixty. There is a history of chronic constipation. The onset is sudden. *Pain* appears early; is not so severe as in the previous case; is intermittent at first, and then continuous with exacerbations; is mostly felt about the region of the sigmoid flexure. *Vomiting* appears less early, is less severe, and less copious than in the previous case. In 15 per cent. of the cases it becomes stercoraceous. It gives relief. *Constipation* absolute. No discharge of blood from the anus. *Tenesmus* in 15 per cent. *Meteorism* early and increasing rapidly. The distension may cause displacement of the thoracic viscera and dyspnoea. The distended sigmoid flexure may be evident. *Peritonitis* is apt to develop.

Leading features.—Acute symptoms, with great and early meteorism in an adult over forty.

3. Acute intussusception. *History.*—Mostly in the young. 50 per cent. of the cases are in patients under ten years. Often a history of unsuitable diet. The onset is sudden. *Pain* is severe at first, then tends to subside; is at first usually distinctly intermittent, then becomes continuous with exacerbations. May be localised in right iliac fossa. *Vomiting* does not appear so early as in the two previous cases; is often scanty. In 8 per cent. there is no vomiting. In only 25 per cent. does the vomiting become faeculent, and then on an average about the fifth day. *Constipation* is rare; diarrhoea is the rule. In 80 per cent. there is a discharge of bloody mucus from the anus. This is derived from the engorged intussusception. *Tenesmus*, which is often very severe, is met with in 55 per cent. of the cases. This symptom must not be too fully relied upon. The most severe case of *tenesmus* I have seen in a child was in a subject of gangrene of the appendix. *Meteorism* is usually absent, and the belly wall is flaccid. In 50 per cent. of the cases a definite tumour is found. It is usually in the line of the colon and most often on the right side. It is sausage-shaped, is not well-defined, is apt to change its place, to increase in size and density during attacks of pain, and to be the seat of tenderness. It is dull on percussion. A tumour may be felt in the rectum, or the invagination may protrude from the anus. In the right iliac fossa there may be a sense of loss of resistance or an actual void, due to the absence of the caecum in the ileo-caecal form. This comparatively rare symptom is called the *signe de Dance*.

Leading features.—A child with acute abdominal symptoms,

marked by intermittent pain, tenesmus, a discharge of bloody mucus from the anus, and possibly a sausage-shaped tumour to be felt in the belly or reached by the rectum.

4. Acute obstruction by gall stones, foreign bodies, etc. *History.*—Foreign bodies swallowed. Gall stones are much more common in females than in males. The average age is fifty to sixty-five. Gall stones may have been passed. A history of hepatic colic. The onset is not markedly sudden. The *symptoms* are those of obstruction by bands, but none of them are, as a rule, of the same degree of severity and acuteness. The collapse is not so marked; meteorism is slight or absent. Large gall stones and foreign bodies have, in rare cases, been felt through the parietes.

Leading features.—Acute obstruction following upon the swallowing of a foreign body or the passing of a gall stone. When the gall stone is lodged in the jejunum the vomiting is often remarkably severe, copious and persisting.

B. The chronic cases; distinguishing features. (1) Stenoses of the small intestine. *History.*—Non-cancerous strictures occur about early middle life, and are often preceded by a history of dysentery, tuberculosis, injury, or hernia. Cancerous strictures are rare before forty.

The *course* is very irregular. Acute attacks of varying severity appear from time to time. In the intervals the symptoms of obstruction may subside. The *pain* is intermittent at first, with long intervals of freedom from distress. In time these intervals become shorter and the attacks of pain longer and more severe. Pain is often increased by food, especially if indigestible; it is usually not increased by purgatives, at least not at first. In time the obstruction usually becomes complete. *Vomiting* is at first replaced by nausea. It appears in the later attacks, is often provoked by food, is scanty, and very rarely fæculent. *Constipation* occurs in 60 per cent.; constipation with diarrhœa in 40 per cent. of the cases. The constipation is absolute during the acute attacks. No tenesmus; no blood per anum. *Meteorism* absent, except when there is actual obstruction. Coils of intestine in movement are visible through the parietes. A tumour is manifest in 30 per cent. of the malignant cases. The patient *emaciates*, and is worn out by pain and digestive disturbances.

2. Stenoses of the large intestine.—The *history* and *course* are the same as in the previous case. The *pain* has the same general character, but is less severe, and is less distinctly affected by food. It is increased by purgatives after a while. The *vomiting* appears later, is scantier, is not provoked by food, and is never fæculent, except after many days of absolute obstruction. *Constipation* is the rule. In cancer, diarrhœa with constipation is common, and blood per anum is noted in about 15 per cent. of the cases. Tenesmus is common in cases associated with diarrhœa. *Meteorism* is often pronounced, especially when constipation exists. In 40 per cent. of the cases of cancer a tumour is noticed. Coils of bowel in

movement are visible through the parietes. The *emaciation* is less rapid.

3. Fæcal accumulation. *History.*—The patients are adults, are often hypochondriacs, and are more often female than male. There is a history of increasing constipation of long standing, with declining appetite, foul tongue, most offensive breath, flatulent dyspepsia, occasional nausea, and much lassitude and depression. *Pain* develops gradually, is slight, and as a rule at first paroxysmal, and then continuous with exacerbations. Later in the case it is distinctly increased by purgatives.

Vomiting appears late, is scanty and irregular, and never fæculent until after a considerable interval of complete obstruction. *Constipation* is pronounced and increasing. There is neither tenesmus nor blood per anum. *Meteorism* is gradual and progressive, and may be considerable. The abdomen feels full and doughy. A tumour (fæcal mass) is usual; it is most often in the cæcum or sigmoid flexure. (See Fig. 783.) It is usually movable, is firm, doughy in some cases, hard in others, and commonly nodular on the surface. The cancerous tumour is, as a rule, not nodular, and is indeed flat on its superficial surface. The fæcal tumour is—unlike the malignant mass—often tender, a symptom probably due to the presence of a stercoral ulcer. The *emaciation* is not rapid, but the patient suffers seriously from the occasional obstructive attacks.

4. Chronic intussusception.—No form of intestinal obstruction presents more variable and more uncertain symptoms than this. Most of the recorded cases were never diagnosed during life or before operation.

History.—More often in males than females, and most common during active adult life. In 35 per cent. of the cases the trouble begins acutely, and then becomes chronic; in other instances the onset is most insidious. The course of the disease is most irregular. The *pain* is distinctly intermittent, and is seldom severe. *Vomiting* is marked in only half the cases. It is of uncertain occurrence, and is usually associated with attacks of pain. It may be increased by food. Fæculent vomiting is exceedingly rare. The *bowels* are very irregular. Sometimes there is constipation, but more often diarrhœa. Tenesmus in 13 per cent., and blood per anum in 50 per cent. of the cases. *Meteorism* absent. *Tumour* discovered in 50 per cent. of the recorded examples, and a mass felt per rectum in 32 per cent. The patient often dies of marasmus.

I have met with three cases in children in which chronic intussusception was mistaken for tuberculous peritonitis.

General diagnosis of intestinal obstruction.—Almost any acute trouble within the abdomen may, during the first few hours of its existence, be mistaken for intestinal obstruction. Most of the cases become differentiated in the course of time.

In every suspected case of intestinal obstruction the previous history should be fully inquired into. The abdomen should, of course, be carefully examined, but as a matter of routine an

examination should be made of the hernial orifices, and of the rectum. Enemata as a means of diagnosis are most deceptive, and are practically valueless. They often cause great distress. The long tube is still more deceptive and more valueless, and at the same time more dangerous. The tube tends to become bent upon itself. I convinced myself by an extensive series of experiments on the dead body, and by many clinical observations, that the long tube can never be passed beyond the sigmoid flexure.

The disease which most nearly imitates intestinal obstruction is *peritonitis*, especially the localised form, due to mischief in the appendix. The main points in the differentiation of these disorders are the following :—

The temperature is usually raised in peritonitis when the patient is not in a condition of collapse. In acute obstruction it is nearly always subnormal. The pain in peritonitis is more continuous and is less like that of colic. The vomiting in peritonitis is less urgent, less copious, less frequent, and practically never really feculent. The constipation is less absolute. In peritonitis the skin of the abdomen is hyperæsthetic, the belly wall is hard and board-like, and there is great tenderness on pressure. The belly is indeed not distended, but is smooth and firm. No peristaltic movements are evident in peritonitis, the patient is usually less restless and more in the habit of keeping the knees flexed and the hands above the head. (*See page 612.*)

Prognosis and terminations in intestinal obstruction.—

In genuine cases of acute intestinal obstruction there is so extremely slight a prospect of spontaneous relief that that possibility—which has been exaggerated by imperfect reports of cases and errors in diagnosis—may be disregarded when the question of treatment is considered. Except in quite rare instances, all the cases, if untreated, end in death. The prospect of spontaneous recovery in acute intussusception has been alluded to (*page 636*).

The average duration of a case of strangulation by bands, etc. (from the onset until death), is five days, of volvulus of the sigmoid flexure six days, and of acute obstruction by gall stones seven days. The most acute cases of intussusception may end fatally in twenty-four hours. The ordinary acute cases may be expected to end in death in two to seven days, and the subacute cases in seven to thirty days.

Cases of chronic obstruction may be extended over many months. Patients with stricture of the bowel may, if carefully treated by medical measures, survive for eighteen or twenty-four months. The course of a case of fecal accumulation is still more indefinite. In general terms it may be said that the probable duration of life in a case of chronic obstruction is from three to six months when once the obstruction symptoms have become definite.

Death is most usually due to peritonitis or to that form of septic intoxication which marks the less vigorous and sthenic phases of that inflammation.

Ulceration and perforation of the bowel are common. The strangulated loop or the intussuscepted gut may become gangrenous. The over-distended bowel may give way. Enteritis appears in a few instances, while in a small proportion of cases death is due to a septic pneumonia. In the most chronic cases the patient may die of marasmus and exhaustion, worn out by the continued pain and vomiting and starved to death from the inability to assimilate food.

Treatment of acute intestinal obstruction. (1) **Strangulation by bands, etc.**—Under this heading is included strangulation through certain apertures (*See* page 631.) The treatment of internal hernia is dealt with on page 656.

It is needless to say that in this and in other forms of acute obstruction the patient must be kept absolutely at rest. Collapse may be met by warm bottles, and the intense pain by hypodermic injections of morphia. It must be remembered that morphia will tend to mask the symptoms, and that under its use the pain lessens, the pulse improves, the expression becomes less ghastly, and the vomiting may be, for a while, placed in abeyance. No food should be given by the mouth. It is useless. Thirst may be relieved by sucking a little ice and by rectal injections of warm water. In cases in which the thirst has been maddening I have seen no objection now and then to allowing the patient to take a copious draught of fluid (hot if possible). He almost immediately rejects it, but it serves in a way to wash out the stomach and makes the man for a little while more comfortable and more contented. Flannels wrung out in hot water and applied to the abdomen may do something towards relieving the pain.

There is only one measure of active treatment, and that is by abdominal section. The sooner the operation is carried out the better; and it should be done as soon as the diagnosis has been established, and as soon as the first symptoms of shock have passed off a little. The operation of opening the abdomen is in itself a small matter; delay is fatal. To temporise is quite useless. In this form of obstruction spontaneous relief, while not absolutely impossible, is yet excessively rare, rarer much than is the relief of strangulated hernia by spontaneous means. The abdomen should be opened in the median line. The incision should be large enough to admit the hand. The cæcum is sought for, and if found non-distended, the obstruction will be in the small intestine. The hernial apertures about the groin, especially the obturator, may be examined *en passant*.

There is seldom great difficulty in discovering the obstructing band. The increasing distension and engorgement of the bowel may lead to it; a coil that is found to be held may lead to it, and its position may be indicated by the collapsed loops below the obstruction.

So many forms of acute intestinal obstruction are met with about the right segment of the abdomen below the umbilicus that attention should always be directed to that part at an early stage. As

soon as the obstructing agent is discovered it should be dealt with. Bands and omental strands are ligatured and divided. Meckel's process, too, may need to be sutured at either end after section. Apertures and slits are opened up and the bowel is set free. It is not, however, the actual strangulation of a loop of gut which is leading directly to the patient's death at the time of the operation. If he dies, he dies from septic poisoning, and the septic matter is derived from his own intestine. It is therefore desirable in these acute cases that an opening should be made in the distended bowel and the contents allowed to escape. This may be done by a trochar and cannula. The incision may be closed or may be left open as a temporary artificial anus, according as to whether the evacuation of the bowel is efficient. The mortality of the operation for acute intestinal obstruction is very high, possibly 75 per cent. But it is becoming lower, and will no doubt be materially reduced when operations are performed earlier and are not considered complete until the bowel has been emptied.

In the most urgent and most advanced cases of all—the neglected cases—it is desirable to do as little as possible, and the best results (such as they are) have attended the opening of the abdomen without an anæsthetic, and the rapid establishment of an artificial anus in the first coil of distended bowel met with. No search is made for the cause of the obstruction. This crude measure has been attended with no little success. Indeed, the treatment of acute intestinal obstruction by enterotomy (or rather enterostomy) has provided the most successful series of operations met with in connection with this trouble. When the condition of the patient will allow, the washing out of the stomach after the operation with hot water is of very material service. At any time it gives marked relief, but although enthusiastically advocated by many, is, of course, only a palliative measure.

2. Volvulus of the sigmoid flexure.—There is no evidence to show that spontaneous cure ever occurs in this affection when the twist is complete and well defined. Unless relieved the condition would appear to be always fatal. General measures of treatment have been alluded to in dealing with obstruction by bands (page 650). The abdomen should be opened, and the coil emptied by means of a large trochar.

It is seldom possible to unfold the volvulus while the gut is distended, although an attempt in that direction may be tried and has been successful. When the quite empty loop has been reduced it will be noticed that as gas enters it from above and distends it the volvulus tends to re-form. In such a case it is better to establish a temporary artificial anus in the summit of the loop (at the point punctured). The practice of suturing the loop in position is likely to give rise to trouble at a later period.

3. Acute intussusception.—For general measures of treatment see page 650. Opium or morphia is very necessary in these cases to stop all peristaltic movement. An attempt may be made

(especially in children) to reduce the invagination by means of air introduced into the rectum. This is most conveniently done by means of Lund's insufflator (Fig. 786), and is carried out under ether. In the place of air, water may be used, and in such case the child's pelvis should be much raised. If the invagination be reduced by these means, it is very apt to re-form again. Inversion of the body is a violent measure, which has on neither theoretical nor practical grounds anything to recommend it. Failing reduction by the insufflator, the abdomen should be at once opened. No excuse can exist for delay; the longer the case is left the more difficult does reduction become. In more than one-half of the cases of operation reported reduction was found to be impossible. The invagination is overcome partly by traction upon the intussusceptum, and partly by

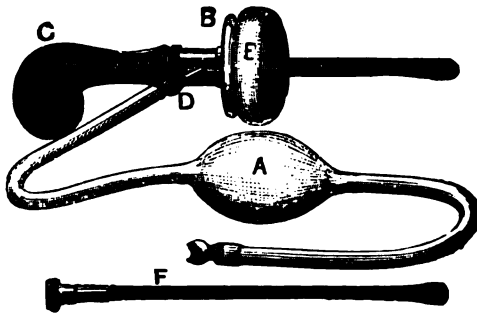


Fig. 786.—Lund's Insufflator.

A, Air syringe; B, shoulder on end of handle; C, D, point where air enters the rectum tube; E, hollow elastic ring; F, a long, narrow rectum tube for cases of rectal stricture, etc.

squeezing of the intussusciptions. If it be reduced it is well, and the abdomen may be closed. Failing reduction four courses are open, or rather have been advised:—

(1) To cut away the whole of the invagination, and to unite the two ends of the divided bowel by suture. This is only suited for small invaginations, and for cases in which the patient's condition is still good.

(2) To cut away the invagination and establish an artificial anus. This measure has been attended with some faint success.

(3) To leave the intussusception untouched, and establish an artificial anus above it. This procedure is not satisfactory. It leaves the invaginated bowel to progress probably towards gangrene, and encourages a condition which will render the fæcal fistula permanent.

(4) To establish a communication between a loop of bowel above the obstruction and a loop below. This measure—known as short-circuiting or as intestinal anastomosis—leaves the invagination alone, and has at present few but theoretical features to recommend it.

It must be confessed that none of these four procedures has

been attended with any encouraging success ; they must be ranked as quite desperate measures, which delay in operating has forced upon the surgeon.

Braun has collected sixty-three cases of operation for invagination. In fifty-one attempts at reduction were made and in twenty-six the gut was reduced. Out of the fifty-one, forty died and eleven recovered. In ten cases resection of the bowel was performed, but no patient recovered ; cases of recovery after resection have, however, been recorded. There is a slight prospect of recovery in intussusception by spontaneous means—namely, by gangrene of the intussusceptum—and when in an acute case days have been allowed to elapse, the prospect of success by operation is so slight that, so far as statistics at present indicate, it is better to leave the case “to nature.” If the enormous number of unpublished cases of late operation in intussusception could be brought to light, this course would receive definite support.

Elimination of a gangrenous intussusception takes place in about 42 per cent. of the cases, and the death-rate among those in whom it does occur is over 40 per cent.

The prospect of spontaneous recovery, therefore, is small, but it would appear so far that the prospect of recovery from a late operation is smaller. An operation to be of service should be performed at once, and without any delay when once insufflation has failed.

The following statistics published by Mr. Barker in 1888 will emphasise the above points :—

LAPAROTOMY FOR INTUSSUSCEPTION.

Bowel reduced, 34 cases—22 died, 12 recovered.

Bowel irreducible, 39 cases—38 deaths.

(a) Abdomen closed, 5 cases—5 died.

(b) Intussusception resected, 14 cases—13 died, 1 recovered.

(c) Artificial anus formed, 10 cases—10 deaths.

(d) Laparotomy with artificial anus, 10 cases—10 deaths.

(4) **Acute obstruction by gall stones, foreign bodies, etc.**—In certain of these cases relief has attended the free administration of opium, followed after a while by copious and repeated enemata.

In the acuter cases laparotomy should be performed, and the incision made in the median line, unless other local indications exist. An incision is made in the bowel, and the foreign substance extracted. If the gut at the seat of the impaction be sound and the distension slight, this incision may be closed by sutures. If, however, it be much congested or ulcerated, or in a state of approaching gangrene, and greatly distended, a temporary artificial anus should be established.

Treatment of chronic intestinal obstruction. 1. **Strictures and stenoses of the intestine.**—Much can be done in these cases by strict attention to dieting, which will involve the

selection of such easily-digested foods as will leave little *débris* in the bowel. Pepsine and other artificial digestives are of value. The bowels must be kept acting by laxatives and frequent enemata. No advantage attends the use of the so-called "long tube"; this tube cannot be passed beyond the sigmoid flexure, as I have many times demonstrated. Massage is often of considerable service in maintaining an action of the bowels. Salol or other intestinal antiseptic will be found of service in lessening the tendency to decomposition in the bowel. As far as his movements are concerned, the patient must regard himself as an invalid.

Sooner or later operative measures will be called for. These are represented by—(a) the establishment of an artificial anus; (b) the resection of the bowel at the strictured part; (c) the establishment of an intestinal anastomosis.

(a) The establishment of an artificial anus is not adapted for strictures in the small intestine, except as a means of warding off impending death. An artificial anus high up in the small intestine leads soon to death from malnutrition. This operation (enterotomy or enterostomy) has been usually carried out in cases which, after being for some time chronic, have become suddenly acute.

The establishment of an artificial anus in the colon (colotomy or colostomy) is a measure attended with a very fair degree of success. A patient may live for years with an artificial anus in the sigmoid flexure, and in many cases of malignant disease a colotomy represents all that can be done.

The risk of the operation depends upon the seat of the obstruction and the duration of the obstruction. Iliac colotomy in cancer of the rectum carries with it an immediate mortality of about 3 per cent. Iliac colotomy on the right side performed for some obstruction in the colon—*e.g.* at the hepatic flexure—is attended with a very much higher mortality, probably 20 per cent. The general mortality of colotomy by any methods, and for diseases of all kinds, is given by Dr. Batt as 38 per cent. Dr. Batt's statistics, however, extend far into past years, and also include a large number of operations for imperforate anus.

As to the duration of life after colotomy for malignant disease, among forty-six patients who recovered from the operation, twelve died within six months, and fifteen between six and twelve months; ten lived to some time between the first and second year, eight died between the second and third year, and one before the fourth year.

In comparing iliac with lumbar colotomy, the advantages claimed for the former are that the operation is more easily and more readily performed, that the bowel can be examined and a diagnosis made, and that the situation of the artificial anus is no more inconvenient than when placed in the loin. Lumbar colotomy is sometimes to be preferred in cases of obstruction attended with very considerable distension of the abdomen.

(b) The resection of the bowel at the strictured part with immediate suture and closing of the abdominal wound is, of course, an

ideal measure. It cannot, however, be often carried out. In one series of cases the disease is too extensive, as in examples of cancer where the trouble has spread beyond the gut. In another series the obstruction is marked, and the patient's condition not such as to allow of a long operation. In very many instances, therefore, and more especially in connection with cancer of the colon, an artificial anus has been established at the seat of the resection. Kendal Franks has collected fifty-one cases of colectomy for cancer, with a mortality of 40·8 per cent.

Statistics such as Reickel's, which include operations of all kinds, give the general mortality of enterectomy as 50 per cent.

The amount of gut removed has usually been a few inches. Koeberlé removed 6 feet of the small intestine for multiple stricture with success.

(c) The establishment of an intestinal anastomosis is an alternative to an artificial anus. A coil above the obstruction is made to communicate with a coil below. The strictured part is thus eliminated from the intestinal canal. This measure would appear to be especially indicated in such conditions of disease in the intestine as are not capable of being removed by operation. As an alternative for colotomy it may often be entertained. The operation has hardly proved as yet so successful in practice as it appeared to be in theory, but it has, nevertheless, been attended with quite encouraging results.

In simple stricture of the intestine an operation (enteroplasty) has been advised upon the same plan as pyloplasty for non-malignant stricture of the pylorus (page 579). The measure, however, still belongs mainly to theoretical surgery.

2. **Fæcal accumulation.**—The treatment of chronic constipation need not be considered in this place. The surgical treatment of this form of obstruction is concerned only with cases where the occlusion has become more or less complete and pressing symptoms have developed. In such cases aperients do more harm than good. Abdominal pain may be relieved by opium or belladonna and by warm fomentations. The diet should be restricted to the simplest food, and to that of the most digestible kind. Milk should be avoided. Enemata should be administered twice daily. They should be given, when possible, in the knee and left shoulder position, and are readily administered by Lund's insufflator, which allows of a considerable pressure being employed. There is no value to be attached to the use of the long tube. Insufflation of the rectum with carbonic acid has been employed by some. Others advise the swallowing of a large quantity of metallic mercury, a measure which has been followed by some success, but also by some calamities. Massage answers well in many cases, especially in the least urgent forms. Electricity is much advocated by some physicians. As soon as action of the bowels is obtained the movement may be followed by the cautious use of aperients.

It is possible that in certain of the most urgent and most obstinate cases iliac colotomy may be called for, but such a measure

must be indicated in but the rarest cases, and in those it is probable that some complication exists.

3. **Chronic intussusception.**—Great attention should be paid to the dieting of the patient. Benefit of a temporary character attends the use of enemata and gentle laxatives with the administration, when pain is present, of belladonna with or without opium. Attempts to reduce the invagination by insufflation or injections of water are not likely to succeed. Rectal intussusceptions have been excised with success per anum. In invaginations higher up the only measure is abdominal section. If the intussusception can be reduced—as is very improbable—that is well. Failing this the mass should be excised. Several successful examples of this operation have been recorded.

INTERNAL HERNIA.

Varieties.—The following varieties come under the above heading:—(1) Diaphragmatic hernia; (2) hernia into the fossa duodeno-jejunalis; (3) hernia into the foramen of Winslow; (4) intersigmoid hernia; (5) pericæcal hernia. Cases of strangulation

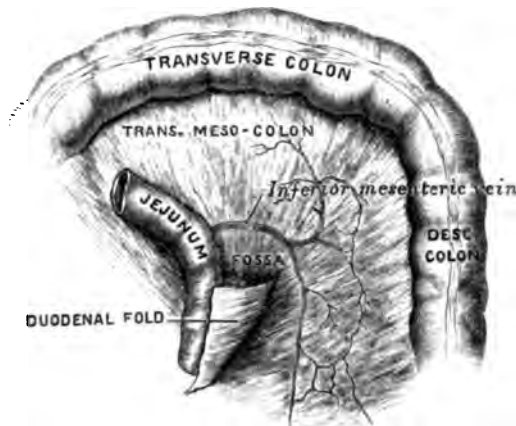


Fig. 787.—The Fossa Duodeno-jejunalis. (Treves.)

through holes or slits in the mesentery and under bands or parts rendered adherent are considered with intestinal obstruction (page 630).

Diaphragmatic hernia is considered on page 404.

2. **Hernia into the fossa duodeno-jejunalis. Pathology**

—This hernia is known by many names, of which the following are the chief:—Retro-peritoneal hernia, meso-colic or mesenteric hernia, meso-gastric hernia, duodenal hernia, and the hernia of Treitz. The fossa duodeno-jejunalis is formed by a fold of peritoneum at the

point where the duodenum ends in the jejunum. It lies to the left side of that point, and its orifice looks upwards (Fig. 787). In well-marked specimens it will engage the thumb up to the first joint. Out of one hundred bodies examined I found this fossa in forty-eight. I have figured it in Morris's "Treatise on Anatomy," p. 1002.

In this remarkable hernia the fossa in question becomes deeper,



Fig. 788.—Hernia into the Fossa Duodeno-jejunalis. (Treitz.) The hernial orifice is displaced to near the cecum. The colon has been drawn aside to show the sac which contains all the small intestine.

and accommodates more and more intestine. As the orifice does not become correspondingly enlarged the bowel is soon hidden from view. The upper jejunum enters first and then the small intestine from above downwards. In a complete case, when the abdomen is opened, of the alimentary canal, only the stomach, duodenum, and colon are to be seen. The whole of the small intestine is lost to view in an enormous sac which is placed behind the posterior parietal peritoneum. The duodenum can be seen to enter the sac and the end of the ileum to leave it (Fig. 788). The sac usually extends downwards on the left side, and may reach the promontory of the sacrum. It lies in

the retro-peritoneal tissue. The cæcum and ascending colon have their normal positions, but the transverse and descending parts of the colon are stretched over and displaced by the sac. In its upper part the sac may reach to the spleen. The renal artery is behind the hernia, and the inferior mesenteric artery is in front of it and to the left. A branch of this vessel, the colica sinistra, is in near relation to the orifice of the sac at its lower part. The inferior mesenteric vein also skirts the orifice of the sac.

The orifice of the sac is usually to the left of the spine and near the ending of the duodenum. It may be displaced to the right iliac region. In some very rare instances the sac has descended upon the right side of the abdomen.

The sac may contain, as already stated, the whole of the small intestine, except the duodenum. It may, however, contain only a few feet of the jejunum. As a rule, these herniæ are large. Strangulation, when it occurs, is always brought about by the neck or orifice of the sac.

Symptoms and treatment.—About seventy examples of this hernia have been recorded. It is more common in males than in females in the proportion of three to one. It has been met with at all ages, but is most usual between twenty-five and thirty-five.

In many of the cases the hernia was discovered *post mortem*, and there was no evidence that it had given much, if any, trouble during life. In other instances the patients were the subjects of continual dyspepsia, constant colic with constipation and occasional vomiting and much flatulent distension of the abdomen.

In some a cyst-like swelling, resonant or partly resonant on percussion, was noticed to the left of the umbilicus.

In a third series of cases the symptoms were those of chronic intestinal obstruction, with constipation, colic, and vomiting. A dull, soft, well-defined tumour was now and then noted in the left side of the abdomen. In the region of the right colon the abdomen was retracted.

In a fourth series of cases there was acute strangulation; death ensuing in from two to eighteen days.

I am not aware that this hernia has ever been diagnosed during life, or that any operation performed upon the subject of it has been successful.

Should it be encountered the sac should be freely opened up, care being taken of the vessels in relation to the orifice. The rent made in the peritoneum should be left unclosed.

3. Hernia into the foramen of Winslow.—The hernia takes place through the foramen of Winslow, the protruded viscera entering the lesser sac of the peritoneum behind the stomach. Eight cases at least have been recorded.

It is met with in adults, and in men more often than in women. The part of the bowel involved is usually a part of the colon. It is rare for any large part of the small intestine to enter into the hernia. In some instances the rupture was discovered *post mortem*, and

nothing was known of the clinical history. In most of the other cases the symptoms were those of acute strangulation. I have reported a case in a man aged twenty-six. The symptoms were acute. I performed laparotomy and discovered the cæcum, ascending colon, and part of the ileum strangulated by the margins of the foramen. All attempts at reduction failed, and at the autopsy I was unable to reduce the bowel until I had divided the hepatic artery, portal vein, and bile duct.*

4. **Intersigmoid hernia.**—A fossa or pouch of peritoneum is often found in the sigmoid meso-colon. It is formed by the layers

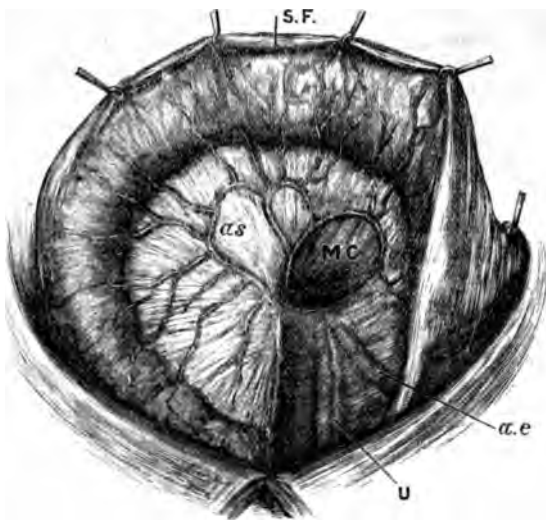


Fig. 789.—The Intersigmoid Fossa. (Jonnescio.)

S.F., Sigmoid flexure drawn up; M.C., sigmoid meso-colon; U, ureter; a.s., sigmoid artery; a.e., external iliac artery. The fossa is just below the letters M.C.

of the meso-colon, and is produced by the sigmoid artery. It is placed over the bifurcation of the iliac vessels, and is known as the intersigmoid fossa (Fig. 789). It is funnel-shaped, and opens to the left. A hernia may take place at this spot.

The sac formed by the gradual distension of the pouch may be small, but in one case it was as large as an adult head, and contained two-thirds of the small intestine. In the smaller forms the lower part of the ileum is concerned. Three cases have been recorded, two in women, and one in a man; the ages were respectively fifty-seven, sixty-three, and sixty-five. In two cases the symptoms were acute, and rapidly fatal. In the other case there were chronic bowel troubles—colic, vomiting, constipation, thirst, frequent micturition, and pain and swelling in the left iliac fossa. This case ended acutely.

* *Lancet*, Oct. 13, 1888.

Treatment by laparotomy and liberation of the bowel is, of course, the only measure available.

5. **Pericæcal hernia.**—Certain fossæ are met with about the cæcum. They are formed from the peritoneum, and the two chief are the superior and the inferior ileo-cæcal.*

Herniæ have occurred in one or other of these pouches.

The sac is usually small, and passes upwards behind the cæcum and ascending colon. It usually has contained coils of the lower ileum.

Some twelve examples have been recorded. In four the hernia was discovered after death, and the bowel found to be free of any strangulation. In the other eight cases the patients died with symptoms of more or less acute strangulation in the course of a few days. In most of these instances the onset was sudden; in a few there had been long-existing intestinal uneasiness. The proportion of males to females was as four to one, and the ages ranged from twenty-five to forty-five.

I believe no case has been dealt with by operation. An early laparotomy represents the only measure of treatment.

THE EXAMINATION OF THE ABDOMEN.

The patient should lie flat upon the back in a warm room and the whole of the abdominal area should be well exposed. The head should be supported upon a single small pillow and the thighs should be parallel and extended.

Inspection.—Inspection may reveal a tumour of any organ should it be large enough to lift up the parietes. A hydatid tumour may be seen bulging over the region of the liver, or a large spleen may be evident, and possibly even its margin may be visible. Ovarian and renal tumours also soon make themselves evident. In instances of chronic partial obstruction of the bowel, visible coils of intestine may be seen moving beneath the parietes. A greatly dilated stomach may cause a visible swelling, especially (as is common in pyloric cancer) when the bowels are empty. A limited distension of the small intestine may cause a definite swelling about the centre of the abdomen (Fig. 784); whereas, when the distension is restricted to the colon, there is a bulging in the region of the ascending, descending, and transverse parts of the colon, while the region below the umbilicus is normal (Fig. 785).

Manual examination.—The hand should be quite warm and should be placed flat upon the abdomen. Its movements should be slow and steady and the amount of pressure employed should be increased gradually.

Tumours in the parietes are usually recognised by their undoubtedly superficial position. In order to demonstrate their relation to the abdominal wall, the patient should be asked to

* See Article by Author in "Morris's Treatise on Anatomy," p. 1007.

raise the shoulders from the couch without any assistance from the hands. By this movement the abdominal muscles are contracted, and while a parietal tumour is usually made much more evident, an intra-abdominal tumour is at once obscured. The term "*phantom tumour*" is often applied to a more or less abiding contraction of some part of the rectus muscle. The section most often found so contracted is the uppermost division of the muscle. It must be remembered that the spinal nerves which supply this muscle also supply the skin over it, and send branches—through the splanchnic nerves—to the viscera beneath it. The phantom tumour often appears to be tender, owing to hyperæsthesia of the skin covering it. This so-called tumour is usually not a merely "nervous" phenomenon. Indeed, it is not a common feature among the manifestations of the hysterical. It very often depends upon some mischief in the viscera. I have seen three cases of phantom tumour which were associated with cancer within the abdomen, and others which have been attendant upon various abdominal diseases. This tumour, therefore, should not be regarded as a merely neurotic exhibition.

In peritonitis the hyperæsthesia of the surface, the rigidity of the belly wall, and the patient's posture are all very manifest features.

In the examination of any **abdominal swelling** the examination should be made not only while the patient lies upon the back, but also when he is turned over upon one or other side. The patient should also be made to take up a position upon the hands and knees (as if crawling). An examination of the abdomen in this attitude is often of the very greatest service.

In order to obtain a momentary relaxation of the abdominal muscles it is well to instruct the patient to take a deep inspiration and then to hold his breath as long as possible. In the gasp he takes after this pause the abdominal muscles become usually well relaxed for a moment, which, although brief, may serve to make evident some doubtful feature in a tumour.

The pulsation of an aneurysm is not difficult to distinguish from that due to an impulse communicated to a tumour (*e.g.* of the pancreas) from the aorta. When the patient is on the hands and knees the transmitted impulse is lost while the aneurysm exhibits an unabated pulsation.



Fig. 790.—Ovarian Tumour growing on the left Side.

In the great majority of cases of abdominal swelling it is desirable, as a matter of routine, to make a rectal and possibly a vaginal examination.

The leading features of a few of the chief abdominal swellings will be briefly indicated.



Fig. 791. — Large Renal Tumour.
(From a case of Mr. Clutton's.)

In **ascites** the belly is evenly enlarged and perfectly smooth. There is a bulging of the flanks. There is a more or less extensive area of dulness on percussion. This depends simply upon the amount and behaviour of the contained fluid. The dulness will, of course, be marked at first only in the most dependent parts.

When quite small in amount dulness may be evident in the umbilical region when the patient is on the hands and knees. Dulness in the loins is evident while yet the amount of fluid is comparatively small. When the patient turns over upon one side, the uppermost loin becomes resonant, if the colon be empty, while the dulness increases in the dependent loin. When the patient turns over in the opposite direction, the phenomena are, of course, reversed.

Encysted collections of fluid are unaffected by position unless enclosed in a movable cyst. In such case the diagnosis is not difficult. A large pancreatic cyst may simulate ascites, but in the case of the cyst there may be a tympanitic note in one or other loin, or even in the iliac region, and change of posture does not affect the limits of the dull area.

The **ovarian tumour** presents the phenomena of a localised collection of fluid or of a well-defined solid or semi-solid tumour. It arises from the pelvis, often definitely from one side of it (Fig. 790). It can be felt on a pelvic examination. It is usually clear of the uterus, yet the uterus may move with it. The tumour is dull on percussion, but even when the mass is of considerable size there is usually some resonance to be detected (when the bowel is empty) in one loin. In the cystic tumours fluctuation may often be made out.

Hepatic tumour.—Normally the area of hepatic dulness extends upwards in the nipple line as high as the sixth rib, in the

axillary region to the eighth rib, and by the side of the spine to the eleventh rib. The lower margin of the liver corresponds in front and on the right side with the margins of the costal cartilages. The left lobe of the liver extends across the middle line, reaching a point on that line about a hand's breath below the xiphoid cartilage.

In a tumour of the liver the area of dulness is increased, the tumour occupies the hepatic region. Possibly the margin of the liver may be defined and found to be in direct relation with the tumour. The tumour descends on inspiration.

Splenic tumour.—The normal area of splenic dulness is oval in shape, its long axis corresponding to that of the ribs. It extends from the ninth to the eleventh ribs, and between the mid-axillary and the mid-scapular lines.

In the splenic tumour this area of dulness is increased. The margins of the enlarged spleen are often to be very clearly made out, especially the sharp anterior border. In this the notch may commonly be felt. The tumour keeps close to the abdominal wall. It is dull all over. There is no colon in front of it. It obviously comes out from the spleen region, and it descends on inspiration.

Renal tumour.—The normal kidney cannot usually be felt. The kidneys are deeply placed in the loin extending from the eleventh intercostal space to the level of the middle of the third lumbar spine. A horizontal line through the umbilicus is below the level of the normal kidney.

A tumour of the kidney occupies the renal region. It fills up the loin and grows forwards towards the front of the abdomen. When large it bulges out the loin. If one hand be placed between the last rib and the iliac crest and the other over the renal region in front, the mass can be felt to lie between the hands, and can be pressed into and out of the loin. The tumour is rounded and massive. Its lower end may be well defined, but its upper end is lost or quite obscured (Figs. 791, 792). It does not descend on inspiration. The colon lies in front of it: often directly in front of it on the left side, and usually to the inner side in the case of the right kidney. The bowel, when full of flatus, may appear as a tympanitic area, or when empty as a more or less solid tube.



Fig. 792.—Large Renal Tumour. Side view of the case shown in Fig. 791.

XLVIII. HERNIA.

By FREDERICK TREVES, F.R.C.S.,

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Definition and terms.—The term “hernia” is applied to the protrusion of a viscus or part of a viscus from the cavity in which it is contained. By common usage the expression, when employed alone, is considered to refer to a protrusion from the cavity of the abdomen. It is assumed that the escaped viscus is contained within a *sac*—which may not be in all cases perfect—derived from the peritoneum, and that it is covered by soft parts exhibiting no breach of surface. Thus the term hernia is not usually applied to the escape of viscera through a penetrating wound of the abdomen. By *internal hernia* are understood certain forms of intestinal obstruction, in which the mechanical conditions are allied to those associated with the more common disorder, but in which there is no external protrusion of the involved viscus. These “herniæ” are dealt with on page 656.

The word “hernia” (from ἔρως, an offshoot) really signifies a projection, and implies the existence of a swelling standing out from the surface. The terms “hernia cerebri” and “hernia testis” preserve this meaning more closely. They refer to the escape of disorganised brain matter through the cranium on the one hand, or of the tissue of the inflamed testicle through the tunica albuginea on the other. These herniæ may be appropriately spoken of as “offshoots” from the inflamed brain or the inflamed testis. They are dealt with on pages 160 to 163, and in Article LII. respectively.

Hernia, as considered in the present section, is synonymous with the popular term “*rupture*,” a term which is not entirely fortunate, as it assumes incorrectly that some tearing of parts is an essential feature in the production of the trouble.

By *congenital hernia* is understood a rupture, the sac of which is pre-formed, and due to some congenital defect. Examples are provided by congenital inguinal hernia (page 714), hernia into a patent canal of Nuck (page 719), and congenital hernia at the umbilicus (page 727). In *acquired hernia* the sac is formed after birth, and is assumed to be fashioned from peritoneum, which is normally bestowed.

An *enterocele* (έντερον, gut; κήλη, a swelling) is a rupture containing bowel; an *epiplocele* (επίπλοον, omentum) a rupture containing omentum; and a *bubonocele* (βουβών, the groin) refers to a rupture which has not passed beyond the external ring in the groin.

THE ESSENTIAL PARTS OF A HERNIA.

These may be considered under three headings—(1) the sac; (2) the contents of the sac; (3) the coverings of the sac.

1. **The sac.**—The sac is composed of peritoneum, and lines the interior of the hollow swelling or protrusion into which the extruded bowel is received. It is needless to say that it is continuous with the peritoneum lining the abdominal cavity.

Every rupture is provided with a sac. In certain herniæ—namely, in the congenital cæcal variety (page 723), and in some cases of rupture involving the bladder—the sac may be deficient to a varying extent.

Herniæ tend to assume a globular or pyriform outline, and are narrowest at the point at which the escape from the abdomen takes place. This narrowed part of the sac is called *the neck*, the rest of it is called the *body* or *fundus*.

Two varieties of sac are distinguished—the *congenital* or pre-formed, and the *acquired*.

(a) The **congenital sac** depends upon an arrest in the complete development of the peritoneum. Certain protrusions of that membrane, which should have been obliterated or withdrawn, have persisted. Examples of this form of sac are provided by the congenital inguinal and umbilical herniæ, by hernia into the funicular process, and into a patent canal of Nuck. The congenital sac is pre-formed or ready-made. The protruded bowel or other viscus descends independently of it. The sac may exist, but no rupture may occupy it.

(b) The **acquired sac** is formed out of normally disposed peritoneum. The sac and its contents are protruded together; it extends only as the hernia extends. Unlike the pre-formed congenital sac, the acquired sac has to be made.

The *formation of the acquired sac* may be studied in connection with ordinary inguinal hernia. At the internal ring there is first of all a bulging of the peritoneum on straining. This bulging is permitted by the natural elasticity of the membrane, and when the effort ceases the peritoneum returns to its normal condition. In process of time the often stretched membrane loses its power of recovery. It yields, and a funnel-like bulging of the peritoneum is produced. As this protrusion extends down the inguinal canal it becomes less like a funnel and more like a glove finger. The mouth of the sac is at this stage its widest part, and strangulation by the neck of the sac would be impossible. As the hernia reaches more yielding tissues it becomes globular, and ultimately pyriform, and the neck becomes the narrowest part. When the sac is quite small

it has but little hold upon the tissues amongst which it is forced, and can often be pushed back into the abdomen. When, however, it has attained any dimensions, it becomes very adherent to the structures around it, a circumstance which is well demonstrated in the operation for the radical cure of hernia, when the surgeon comes to detach the sac. It thus happens that when the gut in the rupture is reduced, the sac does not return with it.

With regard to herniæ about the groin, it is to be noted that the peritoneum lining the anterior abdominal wall is closely adherent to the transversalis fascia, while its attachments in the iliac fossa are comparatively loose. It is, therefore, from the serous membrane lining that fossa that the material is mainly derived for the making of the sac.

As the sac increases it does not continue to drag down more and more peritoneum from the iliac region, but can enlarge by the extension of its own thin, but expansive wall. In very large herniæ it is evident that, while much of the normal peritoneum has been drawn down to provide for the sac, the further development of that receptacle has been effected by the extension of such peritoneum as has already been protruded. The close adhesions soon formed by the sac would render an unlimited drawing upon the peritoneum an impossibility.

The interior of the sac—whether congenital or acquired—is smooth, but its outer wall, as exposed by dissection, is rough.

The **sac wall** is found in most cases of hernia to be unaltered, and to differ in no essential, as regards density and thickness, from the normal peritoneum. In certain ruptures—especially in large protrusions at the femoral ring, and at the umbilicus—the sac becomes very thin, and if the coverings be equally attenuated, the coils of bowel may be seen through the wasted parietes. The integuments may even become so reduced in substance as to give way spontaneously, and allow the contents of the hernia to escape.

On the other hand, if the sac have been long exposed to pressure, as from an ill-fitting truss, or have been the seat of inflammation, the wall may be found to be much thickened. Sacs so affected may be almost leathery in their firmness, and in some instances in old herniæ the sac wall has been described as being, in whole or in part, of the density of cartilage.

It is not uncommon in ruptures of some standing, which have also been the seat of local peritonitis, to find upon the surface within ridges and folds of varying consistence.

The **neck of the sac** is usually rounded, and its shape will obviously depend upon the outline of the aperture through which it passes. It always occupies the narrowest part of the track along which the rupture has descended. When the sac is very small and recently formed, the neck has no independent existence. It is probable that in such a case the sac, if it were to be reduced, would soon lose its pouch-like form. As the rupture increases, and especially when more peritoneum ceases to be drawn down from the abdomen, the

neck of the sac becomes a more definite part of the hernia. Sometimes the serous membrane about the neck of an acquired sac is thrown into folds, and these folds, as time advances, adhere and form a more or less substantial ring at the neck. In congenital herniæ, on the other hand, and in not a few acquired ruptures, the neck exhibits for a long time no particular change. The general tendency, however, is for the tissues at the neck of the sac to become firm and indurated; in such a case the contents of the hernia may be readily strangulated by the neck, and that strangulation may be maintained after all the tissues outside the neck have been divided. In one or two reported examples of violent taxis, an unusually rigid neck of a sac has been torn away from all its peritoneal connections, and has remained as an isolated ring around the no longer protruded, but still strangulated bowel.

The neck of the sac may be very short and abrupt, as is usual in femoral and umbilical ruptures. It may, on the other hand, be considerably elongated, as is often to be observed in congenital inguinal herniæ.

Peculiarities of the sac.—(1) A very peculiar form of sac is met with in infantile hernia (page 716).

(2) There may be two sacs possessed of a common neck. This is illustrated by the interstitial hernia (page 719).

(3) The sac may exhibit one or more diverticula. This is best seen in femoral hernia where the divisions in the sac are produced by unyielding bands belonging to the cribriform fascia. Elsewhere these bulgings are due to unequal expansion of the sac. (See the case of cæcal hernia depicted in Fig. 822.)

(4) One or more constrictions may be found in the sac, producing the so-called "hour-glass" sac. This is met with almost exclusively in connection with hernia into the patent processus vaginalis (page 715).

(5) The mouth of the sac may become obliterated, owing to non-descent of the rupture, or it may be entirely occluded by adherent omentum, or by an adherent ovary. In such instances fluid may accumulate in the sac thus closed, and the swelling formed is then known as *hydrocele of the sac*. The fluid in this hydrocele is well encapsuled and irreducible, and the condition must be distinguished from cases of ascites, in which ascitic fluid accumulates in the patent sac.

Obliteration of the whole sac may take place either partially or completely after the contents have ceased to be protruded. Under such conditions the mouth tends to contract, and the body of the sac to shrink. A new sac has been found protruding into the cavity of an old sac, the mouth of which was occluded. As just stated, the sac, after the obliteration of its orifice, may become the seat of a hydrocele.

2. The contents of the sac.—Ileum and omentum are the two structures most commonly found in hernial sacs. The omentum is rarely found in ruptures in infancy, but in adults it is met with in

the majority of cases. Owing to the natural inclination of the membrane, omentum is more often found in herniæ of the left side than in those of the right. As a rule, the small intestine and the epiploön retain the same relation in the hernial sac as they have in the abdomen—i.e. the omentum lies in front of the bowel.

Next in frequency after the ileum and omentum are the jejunum and the colon. Hernia of the cæcum is not uncommon; the vermiform appendix has been protruded alone; the sigmoid flexure has been found in ruptures in the left groin, and the transverse colon is not uncommonly found in hernia at the umbilicus. All the other viscera—except the liver and the pancreas—have been found at one time or another in a hernia.

Many examples have been furnished of hernia of the ovary, and not a few of ruptures containing the bladder or the uterus. Wendt discovered the kidney in a right inguinal hernia in an aged woman. The spleen has been met with in a left-sided rupture in a subject with great spinal deformity. Lawrence reported an extraordinary case, in which the gall bladder was found to have entered a femoral hernia on the right side.

Certain *loose bodies* have been now and then encountered in the sac; they are usually small, oval, and of polished surface, and are made up of fat and fibrous tissue. There is little doubt but that they are appendices epiploicæ, which have become detached.

When once protruded, the contents of a hernia may undergo *changes in position*. The bowel may be drawn to one side, and the omentum to the other; or the gut may have passed through a rent in the omentum, and have appeared anterior to it; or a loop of intestine may be found to have become twisted upon its own axis.

Adhesions within the sac are common, and are the result of localised peritonitis. They much more often concern the omentum than the bowel. Adhesion of the gut to the sac is rare. The omentum, on the other hand, appears to be specially disposed to become adherent. The adhesions in the sac may be met with in any form—from soft, recent bands, which break down under the finger, to firm and extensive attachments, which firmly connect the contents with the sac wall. They may take the form of fine bands passing in various directions, and by one such band, if firm enough, a piece of bowel may be strangulated. A stiff fibrous band passing across the neck of the sac may prevent reduction of a non-adherent loop of intestine.



Fig. 798.—Adhesions in connection with Hernia.

1, Limited to the contents; 2, limited to the sac; 3, adhesions between contents and sac.

Adhesions are more common about the fundus of the sac than about the neck. Generally speaking, they may be arranged into *three sets* :—(1) Those which concern the contents only. Such adhesions may cause the bowel to assume the form of a permanent loop, or may reduce the omentum to a rigid ball. (2) Those which concern the sac only, passing from one wall to the other. (3) Those which concern both sac and contents, and which therefore tend to unite the one to the other (Fig. 793). Occasionally the omentum is so intimately adherent to the sac, that the two tissues can no longer be differentiated; or the epiploön may be adherent at two or more points, whereby slits are formed, through which bowel may pass and become strangulated.

Adhesions—and especially those which concern the omentum—may cause the sac to be entirely shut off from the abdominal cavity.

The omentum may be so disposed in the hernia, and so adherent, as to form a pouch or cavity, into which a loop of gut may not only be received, but by the mouth of which it may become strangulated. This constitutes what is known as an *omental sac*.

The **omentum in a hernia** may be found rolled up into a fibrous cord, or matted together into a tough and irregular mass.

In the latter form it soon becomes irreducible, even when no adhesions have formed. The prolapsed omentum may lose more or less of its fat. This is especially marked about the neck, and the epiploön in this situation may become slender and fibrous. On the other hand it may increase in size by developing fat. It has, in a few instances, been the seat of calcareous changes, and cysts, due to a collection of fluid in spaces enclosed by adhesions, have now and then been met with. Tubercle and malignant disease have invaded the omentum in a hernia.

The **bowel in a rupture**, if undisturbed, will probably remain unchanged. In general terms, it may be said that the intestine is much less often the seat of inflammatory changes, and much less often adherent and irreducible than is the omentum. Sometimes the gut is found to be thickened. The hypertrophy is said usually to affect the muscular coat, and to be due to an attempt on the part of the bowel to overcome the resistance offered by a bending or stenosis of the gut, or produced by the pressure of a truss.

3. The coverings of the sac.—These must obviously vary with the situation of the hernia. The opening in the parietes, through which the rupture escapes, usually becomes round and indurated, and in certain situations is displaced in the line of gravity. The different layers of fascia over the swelling tend to become fused together and to be attenuated, muscular tissues waste, the subcutaneous fat, to a varying extent, disappears, and the skin becomes stretched and thinned. On the other hand, the sub-peritoneal fat often increases in amount and in density.

Where the skin is redundant—as in the scrotum—wasting of the coverings of the sac is not usually notable, but in the femoral region and at the umbilicus the parts protecting the rupture may

become, as already stated, so much attenuated as to allow the contents of the hernia to be seen in outline. In not a few instances these coverings have been described as being as thin as goldbeater's skin, and have given way either spontaneously or after slight violence. The pressure of an ill-fitting truss may cause the coverings of the sac to become condensed and thickened, while on the other hand a high degree of pressure steadily maintained by a well-fitting pad is apt to be followed by wasting of the parts beneath it.

THE CAUSES OF HERNIA.

1. **Sex.**—Hernia is more common in the male than in the female, the proportion being estimated at about five or four to one. If the three more common forms of rupture be considered—viz. inguinal, femoral, and umbilical—they are distributed, according to Mr. Macready, as follows:—

	<i>Inguinal.</i>	<i>Femoral.</i>	<i>Umbilical.</i>
Males ...	96·3 per cent.	2·5 per cent.	1·1 per cent.
Females ...	50·5 „	33·5 „	15·8 „

This shows that inguinal hernia is the only common hernia in males, and that, while in females this same rupture is met with in half of the cases, yet femoral and umbilical herniæ are especially conspicuous for their relative frequency in female subjects.

Male infants under one year old are especially liable to present an inguinal hernia; the next most common period for that rupture is from sixteen to fifty—the period of most active life. In female subjects inguinal hernia is likely to appear in infants and in young children; a fair number of cases are met with between sixteen and forty, but after forty the appearance of inguinal hernia for the first time is comparatively uncommon. It is almost the only form of hernia of the groin met with in female children under the age of five years.

2. **Age.**—Hernia is met with at all ages. It occurs with extraordinary frequency in the first year of life in males; and in a less marked degree also in females. During the succeeding years of life there is a steady decline in the number of ruptures observed for the first time. This continues up to about the thirteenth year. After that the appearance of rupture becomes yearly more and more frequent, till about the age of fifty, after which time it becomes less common. The cases which occur shortly after birth depend upon congenital defects. The increase in the production of ruptures, which is noticed after about the thirteenth year, is due to more active exercises, to various employments which are undertaken, and to structural changes dependent upon puberty. Taken all together, the greatest number of ruptures is met with between the ages of sixteen and fifty; this period represents the most active period of life, and includes in women the age of child-bearing. After fifty

there is a much greater reduction in the formation of hernia in women than in men.

3. **Situation.**—Ruptures are a little more common on the right side than on the left; this has been explained by right-handedness, by the position of the liver, and by the inclination of the mesentery to the right iliac fossa. It is said also by some that the right side of the pelvis, and therefore the right femoral ring, is larger than the left.

4. **Heredity.**—Mr. Macready has fully investigated this subject, and concludes “that inheritance is an agent—though perhaps a remote agent—in the production of hernia, and that the influence of the two sexes, when equal numbers of ascendants are taken, is nearly equal.” It is said further that in ruptured persons only about 25 per cent. give a history of hernia in the ascendants.

5. **The condition of the abdominal wall.**—A lax condition of the abdominal parietes may be expected to be among the pre-disposing causes of hernia. In a large proportion of the ruptured it is to be observed that there is some bulging of the belly wall at its lower part. This commonly takes the form of an indistinct pouching on either side of the median line. This pouching or bulging is just above Poupart's ligament, is parallel with it, and extends upwards beyond the crest of the ilium (Fig. 794).

It indicates a diminished capacity for resistance to intra-abdominal pressure, and is best demonstrated by making the individual contract the belly muscles, as by raising the shoulders slightly when recumbent upon a couch. On coughing, also, this peculiarity in the abdominal wall is made evident.

In a young and muscular subject in good condition the abdomen is more or less flattened from before backwards, and this flattening is more marked as the muscles contract. The lateral bulgings just mentioned may be met with in the non-ruptured, but very rarely indeed, when there is a good muscular tone. They are present in the majority of the subjects of inguinal and femoral herniæ, are most fully developed in those subjects, and are commonly more prominent on the ruptured side. They may be observed at all periods of life, but cannot be demonstrated in the corpulent. The existence of these lateral bulgings of the abdomen in a sound man would suggest that he might become the subject of a hernia.



Fig. 794.—The lateral Bulgings of the abdominal Wall sometimes met with in the Subjects of Hernia.

In any but aged or broken-down subjects this enfeebled condition of the belly wall can be greatly improved or even overcome by suitable exercise of the abdominal muscles. The simplest exercise consists in lying flat upon the back, placing the hands behind the head, and then raising the body repeatedly into the sitting position. As a result of these and other special exercises, I have seen in the young adult and the middle-aged subject considerable "lateral bulgings" disappear.

The muscular feebleness of old age or that consequent upon an exhausting illness may cause the abdominal wall to become yielding, flaccid, and pendulous, and thus to predispose to the development of a hernia.

A rapid loss of fat in subjects who were previously corpulent is a predisposing cause of hernia.

The abdominal wall may be weakened by a wound, by rupture of muscular fibres, by suppuration or by long-continued distension, as is seen after labour, after the relief of ascites, or the removal of an abdominal tumour. All these conditions must be placed among the causes which predispose to hernia.

It has been clearly shown that ruptures are more common among those women who have borne children than in the childless. The wearing of a tight band or belt around the belly would appear to encourage the formation of a hernia in the groin.

6. Lengthening of the mesentery.—If in a young subject, free from abdominal disease, an examination of the body be made shortly after death, it will be found that it is not possible to drag a loop of small intestine through the femoral canal (artificially enlarged) on to the thigh or down the inguinal canal into the fundus of the scrotum.

Fig. 795. — Peculiar Prominence of the lower part of the Abdomen met with in some Subjects of Hernia.



It would appear, therefore, that in a hernia in the groin of any magnitude in young subject some elongation of the mesentery is necessary. In the infant would seem that the length of the mesentery will readily allow of a hernial protrusion, and the same is probably correct of the aged.

The part played by the mesentery in the production of hernia has been the subject of much discussion, and in connection with this discussion little value is to be attached to statements founded upon the examination of the bodies of aged persons made many days or weeks after death. It is probable that the elongation of the mesentery has no great concern in the causation of hernia, and it is evident that its influence is at present incapable of precise definition. Lockwood has pointed out that as life advances the mesentery tends to glide down over the bodies of the vertebrae, and to occupy a

level than before. This "prolapse of the mesentery" is not commonly met with before the age of thirty.

A peculiar form of abdomen is noticed in some subjects of hernia. This consists of a flattening of the belly wall above the line of the umbilicus, and of a prominence of it below that point (Fig. 795). Mr. Lockwood has considered that this feature is indicative of prolapse of the mesentery. According to Mr. Macready, however, it is rather to be met with in elderly persons who follow an occupation such as gardening or stone-breaking, which involves much stooping.

7. Occupation.—Hernia is especially common in those who are engaged in laborious occupations. It would appear to be encouraged by such employments as involve physical exertion when the thighs are bent at the hips. This posture tends to relax the structures in the region of the groin, and to increase somewhat the intra-abdominal pressure. Thus hernia is more frequent among platelayers, coal-heavers, and gardeners than among carpenters, printers, and watch-makers. Severe, abrupt, and intermittent exertion, or exertion attempted in men who, although once strong are "out of condition," appears particularly to dispose to rupture.

8. Congenital defects.—The principal herniæ which may be associated with deficiencies in development are (1) congenital umbilical hernia (page 727), (2) congenital hernia of the cæcum (page 723), (3) congenital inguinal hernia (page 714), (4) infantile hernia (page 716), (5) hernia into the funicular process (page 716), or (6) into a patent canal of Nuck (page 719), (7) hernia of the ovary in infants (page 724).

9. The immediate cause of hernia.—This depends upon whatever lessens the capacity of the abdominal cavity, and thereby increases the pressure within that space. The gut is forced out by pressure acting upon it from within. Herniæ have occurred in bed-ridden persons who have become the subjects of an increasing tumour of the abdomen. They have also been produced in patients with ascites or in those who exhibit a rapid growth of intra-abdominal fat. This, the so-called "Pressure Theory of Hernia," is described by Mr. Macready in the following words: "The compression of the viscera by the abdominal muscles may produce a hernia suddenly or gradually at one of the weak spots of the belly wall. Some original or acquired defect of the abdominal wall at those places is present in some cases, is probable in all. In persons structurally perfect the abdominal wall may undergo changes from repeated internal pressure under certain circumstances or from disease and other debilitating influences, whereby it is at length unable to withstand the distension to which it is subject. In those structurally imperfect the defects may be so great as to give rise to early hernia. With defects of lesser degree the structures involved may undergo changes resulting from growth or from various debilitating influences, which diminish still further the strength of the abdominal wall till it no longer resists the intra-abdominal pressure.

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General symptoms.—These vary considerably. There is usually a complaint of some pain, and of a sense of weakness in the groin. These discomforts increase on exertion, and are more conspicuous when the patient is fatigued. Some men will continue for months or years to do their ordinary work although troubled with a rupture, which may be of large size, and which they not only do not support in any way, but do not even take the trouble to reduce. I have known a sailor make several voyages with a scrotal hernia, which he never reduced, and which he declared caused him but little inconvenience. On the other hand, there are patients who complain of a rupture from the first, and who evidently suffer considerable distress so long as the hernia is “down,” and who are rendered unfit to follow almost any employment unless the hernia be supported.

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With the right hand he first of all draws the tumour down a

little, so as to demonstrate and extend the neck of the hernia as far as is possible. With the thumb and fingers of the left hand he steadies the neck of the sac. The digits form a kind of funnel to direct the hernial contents into the abdomen. They prevent the bowel and omentum from being simply pushed up in a bunch against the abdominal wall. With the thumb and fingers of the right hand the surgeon brings pressure to bear upon the tumour. He endeavours to let the pressure be widespread, and squeezes the swelling bodily (if it be large enough) somewhat in the manner in which he would compress an indiarubber ball-syringe which had to be emptied. It is to be remembered that that part of the contents of the sac which came down last should be reduced first. The more recently descended contents will be found at the back of the sac, and it is at the back of the tumour that the first attempt at reduction should be made. When the posterior part of the sac is cleared, the anterior part may be attacked. As the omentum usually lies in front of the intestine, it is evident that the bowel will be—or, at least, should be—reduced before the epiploön.

When the tumour is very large both hands will be needed to compress the swelling, and the neck of the sac may then be steadied by an assistant. When the tumour is very small, then pressure can only be brought to bear upon the hernia through the tips of the fingers.

In any case the pressure must be exercised in the direction of the long axis of the swelling: the hernia must be returned by the same route as it escaped. Thus in a non-pendulous umbilical rupture the pressure is directed backwards; in an oblique inguinal hernia upwards, outwards, and backwards; in a large femoral rupture downwards, then backwards, and a little upwards.

There is no need either to raise the buttocks or to flex and abduct the thigh. The former posture is supposed to allow gravity to assist the surgeon's efforts, and the latter to effect a relaxation of the tissues about the hernial opening. It has, however, been pointed out by many that the taxis is more readily applied when the margins of the opening are not fully relaxed. The flexion and abduction of the thigh are certainly quite useless in dealing with inguinal hernia, but the position appears to be occasionally of assistance in reducing femoral ruptures.

The amount of force employed should never be excessive, and should be measured by an estimation of the strength of the tissues compressed. It is probably useless to persist in attempts at reduction for longer than ten minutes.

In the case of a large hernia, which has been long "down," considerable pain may be experienced when its contents are reduced into the abdomen.

The treatment of reducible hernia.—The treatment may be considered under two heads: (A) by trusses, (B) by operation.

(A) **Treatment by trusses.**—The truss most usually employed for inguinal and femoral ruptures is the steel truss. This instrument

"Hence the principal cause of hernia would appear to reside in imperfection of the structures which form the openings through which herniæ escape. But one factor alone is not, as a rule, sufficient to determine the descent of a hernia, and this is attested by the occasional presence of a congenital opening without a protrusion."

Double hernia.—Inguinal herniæ may appear on both sides at once. This is uncommon, and is mostly met with during the first few years of life. As age advances it is estimated that, among males, 36·6 per cent. of single herniæ in the groin become double, and that this complication is met with in 23·3 per cent. of single herniæ in women (Macready). Inguinal herniæ are much more commonly double than femoral.

THE CONDITIONS OF A HERNIA.

The conditions under which a hernia may present itself may be considered under the following headings—(1) reducible hernia; (2) irreducible hernia; (3) obstructed or incarcerated hernia; (4) inflamed hernia; (5) strangulated hernia.

1. **Reducible hernia.**—In this form the contents of the sac can be reduced more or less readily into the abdomen.

This is the most common condition of a hernia, and is, with few exceptions, the early condition of all herniæ.

The contents only are returned; the sac, if pre-formed, is quite irreducible, and if acquired, very soon becomes firmly adherent. In certain small and recent acquired herniæ the sac may be reduced under exceptional conditions. These are detailed on page 705.

Early evidences.—The patient with a reducible hernia—let us say in the inguinal region—is probably first conscious of a sense of pain in the groin after exertion, followed by some protrusion in the inguinal region. The pain is commonly spoken of as cutting or burning. The part feels weak, and the man is disposed to support it with his hand. The protrusion is at first to be felt rather than seen. It takes the form of a very soft, elastic bulging.

The swelling slowly increases from day to day or from week to week, and when once it is free of the external abdominal ring it may proceed much more rapidly. This applies to acquired hernia. When a congenital sac exists the rupture may extend at once to the bottom of the scrotum, and this descent may be unattended by pain.

In any case the rupture, when of fair size, will take the form of a globular or pyriform swelling, with a more or less defined neck, which can be felt to extend into one of the hernial openings. It is soft and smooth, and elastic to the touch. When the patient stands up, or strains or coughs, the tumour becomes larger and tenser; when he lies down it becomes smaller and softer, or quite shrunken, or may disappear altogether.

When small, the whole of the rupture is usually reduced on

lying down, aided by the least amount of pressure. But in very large herniæ only a part is, as a rule, readily reducible, the remaining portion needing considerable time and pressure and manœuvring for its reduction.

It is remarkable that in infants and children an inguinal hernia may remain reduced for days, weeks, or months, and then return as unaccountably as it disappeared. It is easy to see what mistakes in diagnosis and prognosis this may give rise to.

Local characters.—(1) *When the hernia contains gut* it is well rounded and soft, and markedly elastic. Sometimes the gut can be identified with the fingers. This applies especially to large herniæ with thin sacs, or to such readily recognised parts of the bowel as the vermiform appendix or the colon with its bands and appendices epiploicæ. If the bowel contain flatus it is tympanitic on percussion. If it be empty or occupied with fluid contents, or covered in front by much omentum, the percussion note is of course dull.

When the patient coughs there is a distinct *impulse* to be felt in the rupture. This is to be noticed when the protruded mass is surrounded by the thumb and fingers. The impulse is expansile. There is not merely a shock communicated to the hernia, but it becomes momentarily enlarged, and exhibits—like an aneurysm—lateral expansion. In a stout subject, with a pendulous abdomen and a small hernia, this impulse on coughing is not easily appreciated, and it may be mistaken for the mere shock which is communicated to the hernia by the suddenly-contracted (or it may almost be said suddenly-shaken) abdominal parietes. The more fat there is in a hernia the less clear is the impulse on coughing.

When pressure is applied for the purpose of *reduction*, the contents, when composed of intestine, glide smoothly, and at the last slip back suddenly. This sudden reduction is more noticeable in infants than in adults. If the gut contain fluid at the time there is a very characteristic gurgling to be heard and, if the term may be allowed, to be felt.

Finally it is to be observed that all herniæ in adults are opaque when examined with a light, after the manner adopted in examining hydrocele. In scrotal ruptures in infants, if the contents be composed of intestine, and if at the time the gut contain flatus only, the tumour may be as translucent as a hydrocele.

(2) *When the hernia contains omentum* it is apt to be uneven in outline, to feel “pillowy,” and to lack that even elasticity met with when gut is present.

The swelling, if containing omentum, only feels like a fatty tumour. It often presents variations in density, and is harder in some parts than in others. It is always dull on percussion.

On coughing there is an *impulse*, but it is much less distinct, and the expansile feature in the impulse is very much less marked, and may indeed be absent in small herniæ. It will be affected by adhesions and matting together of the omentum. It is in omental hernia that

the mere shock communicated from the abdominal wall is so readily assumed to be the genuine impulse. Every surgeon must have met with the case of a small femoral hernia in a stout subject, in which repeated examinations have left him undecided as to whether there was a true impulse on coughing or not.

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(A) **Treatment by trusses.**—The truss most usually employed for inguinal and femoral ruptures is the steel truss. This instrument

consists of a steel band or spring, which encircles the body, and of a pad, which maintains pressure over the hernial orifice: the pad is very usually controlled by an under-strap. A *good truss* should be light and yet strong, should fit the body perfectly, and the pad should maintain its position in all movements of the wearer and in all attitudes. During periods of rest the pad should exercise but gentle pressure upon the abdominal wall, but on exertion it should be capable of firmly resisting any protrusion at the orifice it protects.

If the spring press too lightly or be too yielding the truss fails to keep the rupture reduced. If, on the other hand, the spring presses upon the pad too heavily much discomfort is occasioned, and

the excessive pressure tends to cause atrophy of the abdominal wall, and even to enlarge the existing opening. Not infrequently the adjustment of the pad is such that it fails to exercise pressure in the right direction, and the hernia descends behind the pad. If the pad be not accurately in place a good deal of its pressure may be exercised upon the os pubis and not upon the part required. An ill-adjusted or ill-made under-strap may cause much annoyance.



Fig. 796.—Ordinary Inguinal Truss. Note the shape and inclination of the pad, and the posterior attachment of the under-strap.

The steel truss and the method of its application.—The *spring* or band of the instrument, as it is at present made, is the outcome of many years of

experience and of often recurring improvements, and any wide departure from the figure of its curves and the manner of its bending is not likely to be of material value. The spring should fit "comfortably," it should cross the base of the sacrum, and should run around the hips just below the crest of the ilium. If placed above that point it will slip up and down on the edge of bone or be displaced by the abdominal muscles; if placed below the level named it will come within the sphere of action of the muscles of the buttock.

The spring ends on the sound side (in the case of a single truss) behind the anterior superior iliac spine. It thus obtains a good hold for counter-pressure. From the point of the ending of the spring the line of the truss is carried on round the body by means of a thong of soft leather, which is continuous with the coverings of the truss. This is usually called the *cross strap*, and it is

fastened to a stud on the pad. The *shoulder* of a truss is that part of the spring on the ruptured side which is turning round the anterior superior iliac spine to reach the front of the abdomen.

The *pad* is usually made of a plate of soft iron covered with cork. It should always be immovably fixed to the spring. In some trusses the pad is made of wood, ivory, metal, or caoutchouc or is represented by an india-rubber cushion filled with air, water, or glycerine. It has not been shown that these pads have any advantage over the simple one made of cork.

The pad for an inguinal hernia will be about $4\frac{1}{4}$ inches long, $2\frac{1}{4}$ inches broad, and $1\frac{1}{4}$ inch in thickness. That for a femoral hernia will measure about $3\frac{1}{2}$ inches in length, 2 inches or less in breadth, and $1\frac{1}{4}$ inch in thickness.

The inguinal pad is rather pyriform in shape, and is somewhat elongated (Fig. 796). If the upper margin of the spring of the truss be



Fig. 798.—Salmon and Ody's Truss for Inguinal Hernia. The hernia is approached from the sound side.

followed, there need be no change of direction where the spring and the pad join; the lower part of the pad, however, must be inclined downwards to correspond to the obliquity of the inguinal canal. The pad if too small will fail in its purpose; if too large it will be displaced when the thigh is flexed, or will rest unduly on the os pubis.

The femoral pad is much smaller than that used in the inguinal truss (the spring also is lighter). The pad is much more inclined downwards, since it has to rest entirely below Poupart's ligament. It presents a considerable prominence, so as well to occupy the comparatively small femoral opening. It is placed more obliquely with



Fig. 797.—Truss for Femoral Hernia. Note the shape and inclination of the pad, and the posterior attachment of the under-strap.

reference to the spring than is the case in an inguinal truss. If the pad be too large it will press upon the femoral vein, will be disturbed in flexing the thigh, and will cause soreness by rubbing upon the spine of the pubes (Fig. 797).

On the pad of both the inguinal and the femoral truss there are two studs: one is near the upper part about the point of junction of the pad with the spring. To it is fixed the thong of soft leather, which is continuous with the spring of the truss, and which is known as the cross-strap. The object of this position for the stud

is to overcome the tendency of the truss to rise upwards. The second stud is at the lower and inner part of the surface of the pad, and to it is made fast the under-strap.

In an inguinal hernia the *under-strap* starts from a point just behind the shoulder of the truss—and, therefore, not much posterior to the anterior superior iliac spine; it is carried along the fold of the buttock

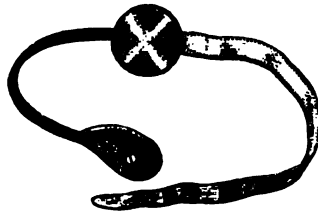


Fig. 799.—Cole's Truss.

and the perineum to the lower stud on the pad. It tends to keep the pad in position, especially during movement.

In a femoral truss the under-strap should start from the spring farther forwards than is the case in an inguinal truss, and should indeed come off in front of the anterior superior iliac spine (Fig. 797).

Trusses covered with an impermeable substance are made to be worn during bathing, and like instruments are used in the case of young infants.

Other forms of truss.—It would be useless to attempt any account of the infinite varieties of trusses which have at one time or another come into some notice. Many have served only to demonstrate by contrast the general superiority of the steel truss.

A few of the more important variations in principle may be mentioned.

Salmon and Ody's truss consists of a semicircular spring attached behind to a large flat pad which rests upon the spine. The spring (when the rupture is single) passes round the sound side of the pelvis, and approaches the hernia, therefore, from the non-ruptured side. The pad is oval, and is connected with the spring by a ball-and-socket joint. Neither a cross-strap nor an under-strap is used (Fig. 798).

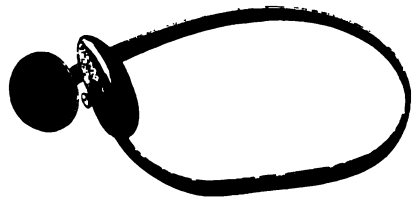


Fig. 800.—Seeley's Hard-rubber Truss.

Cole's truss is somewhat similar to the preceding. There is a semicircular spring attached behind to a flat circular pad, which rests on the spine. The spring encircles the body on the affected side, and there is a cross-strap. The hernial pad is pyriform, and has in its interior a spiral steel spring, which adds to the general pressure exercised by the truss the support of a compressible pad (Fig. 799).

Seeley's truss appears to be much employed in America (Fig. 800). It is a modification of Salmon and Ody's truss. The spring is long, and embraces about two-thirds of the circumference of the body. It terminates behind in a round disc, which lies over the gluteal muscles of the affected side. The spring approaches the rupture from the sound side, and hence the name of "Cross Body Truss." The spring is shaped to the body; the pads are of various sizes and shapes, and are made of hard rubber; the spring is covered with the same material. There is neither under-strap nor cross-strap. Fig. 801, from a photograph provided by Seeley and Co., of Philadelphia, shows the general disposition of the truss when applied to an inguinal and to a femoral hernia.



Fig. 801.—Seeley's Trusses as applied to an Inguinal and to a Femoral Hernia.

The *silver spring truss*, known also as the "frame truss" or "Hood" truss, is advocated by many American surgeons. The so-called spring consists of a light band of German silver, which almost entirely surrounds the pelvis, to the outline of which it is accurately moulded. This metal band is continuous in front, but is open behind, where it terminates in a circular disc on either side of the spine. In front the metal band is rigid, and carries one or two pads as required. These are solid, and are fixed in the desired position by screws. The specimen shown in Fig. 802 is for a double inguinal hernia. These trusses are of undoubted value, and have in

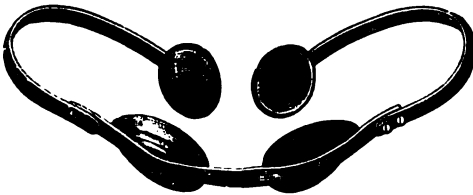


Fig. 802.—The Silver Spring, Frame, or "Hood" Truss. Inguinal pattern.

certain instances retained the rupture when other instruments have failed; they are not adapted for very general use.

In the *moc-main truss* there is no steel spring; the band which surrounds the body is

made only of soft leather; the pad is convex, and of large size; it is placed nearly vertically. Lying in a groove on its external surface is a spring and lever; to the end of this lever is attached the under-strap, and the tightening of this strap causes the pad to exercise pressure over the hernial opening (Fig. 803);

Wood's horse-shoe truss consists of an ordinary steel truss, to

which is affixed a pad of boxwood of horse-shoe shape. It is claimed that a pad of this shape will support the pillars of the external ring and the inguinal canal, without exercising pressure on the cord. It

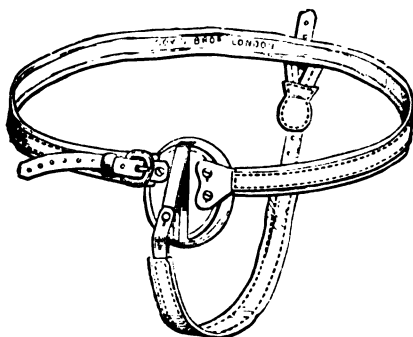


Fig. 803.—Moe-main Truss.

supplies the patient, in fact, with a wooden abdominal ring (Fig. 804).

See also the *hinged-cup truss* (page 691), the *rat-tailed truss* (page 683), the *umbilical hernia truss* (page 731), and the *femoral truss with thigh piece* (page 684).

To measure for a truss.—The patient must be lying down. If the rupture be inguinal or femoral the tape should cross the base of the sacrum, and should come forward just

below the iliac crest to reach the middle line in front. The ends of the tape meet immediately above the pubes. This mode of measurement serves for both inguinal and femoral trusses, and the number of inches recorded will express the "size" of the truss.

To apply an inguinal truss.—The instrument must be put on while the patient is lying down. The crest of the pubes is defined, and the pad is drawn down until its lower extremity is just above the crest and just clear of the bone, and the inner extremity is in contact with the outer edge of the rectus. The cross-strap is first fastened, and then the under-strap. The pad should cover both the inguinal canal and the internal ring. It is all-important that it should cover the latter point. If the pad be too low it will rest upon the pubic bone, and not only cause chafing but will insufficiently protect the hernial opening. The pad should press upwards, backwards, and outwards. Its main direction will be upwards. In a corpulent subject the pad will press almost directly upwards. Great care should be taken to see that the line of pressure of the truss is suitably directed.

The truss should be removed only in the recumbent position, and if in the adult the hernia remain reduced, the instrument need not be worn at nights. In infants and children the truss will usually have to be worn night and day.

If the rupture be scrotal, the ordinary truss may occasionally suffice, but, as a rule, a more substantial instrument is needed. This

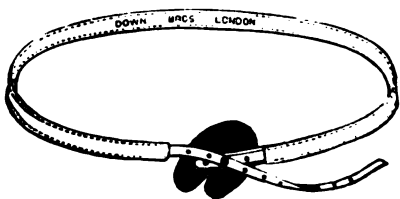


Fig. 804.—Wood's Inguinal Truss with horse-shoe Pad.

is provided by the rat-tailed truss (Fig. 805). The spring in this instrument is stronger than in the common truss; the pad is larger and fuller, and faces more directly upwards. The pad is continued down over the pubes in the form of a conical cushion, which terminates as the under-strap. The iron plate of the pad only extends to the pubic crest. Mr. Macready states that this truss, if worn night and day, may convert a scrotal hernia into a simple bubonocoele.

The truss employed for direct inguinal hernia is dealt with on page 723.

To apply a femoral truss.—The instrument must be both applied and taken off when the patient is in the recumbent posture.

Certain details as to the pad and the position of the under-strap have been already mentioned (page 679).

The pad lies over the saphenous opening, below Poupart's ligament, and just external to the spine of the pubes. Care must be taken that it does not press upon the femoral vein. The pad must face almost directly upwards when the patient is in the erect position. The cross-strap is fastened first, and then the under-strap.

When the femoral hernia is of large size the ordinary truss is useless. It is necessary then to add to this instrument a "thigh belt." This is continued downwards below the pad, and is so padded on its inner side as to occupy the hollow left after the reduction of the hernia. In order to prevent the rupture from escaping above the upper border of the truss, it may be necessary to add an "inguinal piece" in that position. In applying this instrument the thigh-belt must be fixed first, then the cross-straps, and finally the under-straps (Fig. 806).

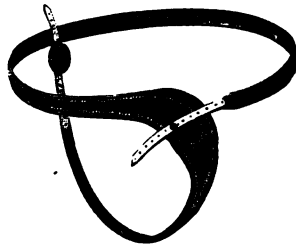


Fig. 805.—Rat-tailed Truss.

Prospect of cure by trusses.—It has been estimated that about 15 or 20 per cent. of cases of inguinal hernia become cured permanently or temporarily by trusses. Some 70 per cent., however, of these cases of cure are in infants under the age of one year. In such subjects there is a great tendency for the hernia to disappear spontaneously, even if no truss be worn. This is more marked in the inguinal herniæ of girls than of boys. As every year of life advances, spontaneous cure or cure by trusses becomes less and less common in inguinal herniæ. Such examples of cure may be said to be very rare after thirty, and to be especially uncommon in female adults. In men who have become entirely "out of condition" as regards their muscular system, and who have developed a slight rupture, a cure may follow on the wearing of a truss, aided by well-arranged exercises which will especially involve the abdominal muscles, and by a healthy mode of life. Spontaneous cures are said to have followed long confinement in bed. These remarks apply to inguinal hernia.

The femoral hernia, on the other hand, appears to be, under all circumstances, practically incurable, so far as treatment by trusses and supports is concerned.

(B) **Treatment by operation.**—From the very earliest days of medicine surgeons have concerned themselves with attempts to cure hernia by means of operation.

The methods either advised or actually employed are legion, and no chapter in the literature of surgery contains more remarkable measures, or more extravagant and more varied efforts of invention.

It is interesting to note that one of the earliest operations—that described by Heliodorus—consisted in the isolation, twisting, and removal of the sac, and that this measure or some modification of it

was revived from time to time, until at last the introduction of antiseptic surgery rendered its employment almost free from the great risk to life with which it had previously been attended.

Among the *abandoned methods of treatment* may be mentioned—

(1) the treatment by increasing pressure, which was maintained by conical linen pads until ulceration was produced; (2) the free use of caustics, and of the actual cautery to the skin; (3) castration; (4) simple ligature of the sac, with a metal or other thread; (5) the injection of fluid into or around the sac, the fluids employed being red wine, iodine,



Fig. 806.—Femoral Truss with "Thigh Belt" and "Inguinal Piece." The line of stitching on the pad shows the outline of the femoral pad. (Macready.)

tincture of cantharides, alcohol, and decoction of oak bark; (6) the method of "healing in" a detached portion of skin, or a portion of infolded skin, which had been invaginated into the abdominal ring. One of the last of these operations was designed by Wutzer (1838). The scrotum was invaginated into the inguinal canal by means of a wooden cylinder, and was fixed in position for some days by means of a concealed needle and a clamp. (7) The treatment by exciting a certain amount of adhesive inflammation in the inguinal canal. Mösner (1846) used a seton. Spanton (1881) freed the sac through an incision, and pierced the sac and the walls of the inguinal canal by means of a spiral corkscrew-like needle, which was left in place for eight to fifteen days. (8) The sewing up of the canal by means of a suture or series of sutures introduced subcutaneously, and either retained permanently or withdrawn at the end of a week or ten days. This measure is illustrated by the complex but not entirely unsuccessful operation of Professor Wood.

The operations at present in use.—These are very numerous. Many differ from one another only in minor matters of

detail, and no precise measure has been introduced which has not in due course been "modified" beyond recognition. The following are the chief methods of operating; each method it will be observed involves an especial principle:—

(1) *The method of Czerny* (1876), *Risel* (1877), *Annandale* (1880), *Charles Ball* (1883), *Mitchell Banks* (1887), and many others.

The sac is exposed and well isolated, its contents are reduced or removed (if adherent omentum). The neck of the sac is ligatured as high up as possible. The body of the sac is excised. The inguinal ring is closed by sutures of catgut, silk, or silver wire. In the early operations the sac was not excised. Many surgeons apply no sutures to the inguinal ring.

Mr. Charles Ball, before ligaturing the neck of the sac, separated the parietal attachment of the peritoneum around the internal ring, and then twisted the loosened sac, so as to curtail as much as possible the peritoneum in the immediate vicinity of the hernial orifice.

(2) *Macewen's operation* (1886).—The sac is not removed. It is carefully separated, not only from the entire inguinal canal, but also from the abdominal aspect of the circumference of the internal ring. It is completely reduced from the canal into the abdomen beyond the internal ring, is then thrown into a series of folds, constituting a pad, which is placed on the peritoneal surface opposite the internal ring. It there constitutes a boss or bulwark. The canal having been refreshed during the removal of the sac therefrom, its walls are brought into direct contact by means of sutures.

(3) *The method of Bassini* (1884) and *Halstead* (1890).—A new inguinal canal and a new internal ring are made. The three muscles of the abdominal wall are divided from the external ring in a direction upwards and outwards as high up as about the level of the anterior superior iliac spine. The sac is separated and entirely cut away. The lineal gap thus left in the parietal peritoneum is closed by sutures. The spermatic cord is transplanted to the upper angle of the wound. The divided tissues of the abdominal wall are united by buried sutures.

(4) *Kocher's operation* (1892); *the Author's operation* (1892).—The sac is well isolated. An opening is made in the abdominal muscles some way above and external to the upper end of the inguinal canal. Through this opening the detached sac is drawn. It is then twisted into a roll, and is fixed by sutures over the site of the inguinal canal. The main point is that the neck of the sac should be brought out through a new opening.

Some time previous to the publication of Kocher's paper I had devised and carried out the following procedure, which I have since employed.

The sac is well isolated, the parietal attachments of the peritoneum about the neck of the sac are freed. The greater portion of the sac is then entirely cut away. The upper portion is seized with rectangular pressure forceps, is ligatured high up, and is twisted into a cord.

This cord is then carried beneath all the structures forming the inner boundary of the external ring (*i.e.* beneath the inner pillar and conjoined tendon) and is brought out through an incision made in the exposed tissues at or near the median line. Here it is fixed in place by sutures. The neck of the sac is thus removed from its normal site; the twisted remains of the sac can be felt as a bar or cord passing across the upper end of the inguinal canal. The canal is closed by sutures.

(5) *The method of Anger (1887) and McBurney (1889).*—This operation is only mentioned because it has been very extensively adopted in America. It has for its object the formation of dense cicatricial tissue throughout the whole length and depth of the inguinal canal. The sac is ligatured at the external ring and excised, the skin is then inverted and sewn to the edges of the deeper tissues to prevent healing.

The gap is packed throughout with gauze, and healing by granulation is obtained. This procedure is not founded upon a sound surgical principle. The firmest and most substantial cicatrix is that which results after healing by first intention. This is to be seen in operation wounds of all kinds. The majority of those who have written upon the radical cure of hernia have pointed out that the best results have been obtained in cases in which primary healing followed, and that in the majority of cases in which suppuration ensued there was a relapse of the hernia.

(6) *Operations applied to umbilical and femoral herniæ.*—The procedures above described are considered as applicable to inguinal hernia. No new principles are involved in the operations applied to other herniæ.

In umbilical hernia the sac is isolated and emptied and cut away; the peritoneum around the margin of the hernial orifice is separated, and united by a continuous silk suture. A line of buried sutures unites the deep structures forming the margin of the ring, and the operation is completed by a row of superficial sutures. The procedure is little other than that attending the closure of a laparotomy wound.

In femoral hernia the sac is usually isolated, twisted, ligatured as high up as possible, and then cut away. If possible, the femoral ring is closed by sutures. Some surgeons form a flap from the muscular or aponeurotic tissues in the neighbourhood for the purpose of covering in the femoral canal. These flaps are, however, too superficial and too far removed from the part needing support—namely, the abdominal extremity of the femoral canal. I have for some years carried out a measure identical with that already described as applied by me to inguinal hernia. The sac is well isolated, and the peritoneum all round the hernial orifice is as well freed as possible. The lower part of the sac is cut away, the upper part (or the whole sac if it be small) is twisted into a firm cord and ligatured. This cord is carried inwards, and is drawn through a slit made in the firm part of Poupart's ligament, close to the pubic spine. Here it

is secured in place by buried sutures. The neck of the sac is thus obliterated, and the serous membrane forming it is entirely diverted. At the femoral ring there is left a bar or pad formed by the rigidly-twisted peritoneum.

The closure of the femoral canal by sutures is often surgically impossible, and if possible is usually inadequate.

The risks and the success of the treatment by operation.—The *danger* of the operation when carried out in non-strangulated cases is very slight, and may be estimated as not above 2 per cent. Among the records of 767 cases by well-known surgeons there are noted only five deaths.

The prospects of *success* after treatment by operation are not so easily defined. It has not been shown that any one method can lay claim to especial superiority. To judge from published reports very admirable results have been obtained at the hands of the inventing surgeons by every procedure which has been brought before the profession. Almost every writer upon the radical cure of hernia has his own method, and with it he obtains satisfactory results. As there seems to be so little need of selection in the method employed, the choice of the surgeon would probably incline towards that operation which is the most simple, the most free from special apparatus, and the most likely to be attended by sound and speedy healing.

On reviewing the recorded cases of six special writers upon the radical cure of hernia, it would appear that the number of failures is only in the proportion of 4 per cent. Were this the case the operation would merit the term of radical cure. Unfortunately, however, cases are lost sight of. Patients who have suffered a relapse are apt not to return to the surgeon whom they consider to have failed. Most of the successful cases are recorded, and most of the unsuccessful are allowed to escape the prominence of publication; in many instances the rupture ceases to trouble the patient for some years, and then makes a reappearance too late to be recorded. These circumstances may serve to explain the fact that the number of cases of relapse after operation met with at odd times in hospital practice are certainly suggestive of a higher ratio of failures than 4 per cent. Bull estimates that failure follows in 30 per cent. of the usual operations for radical cure taken collectively. In advising a patient it would probably be more nearly accurate to assure him that the prospect of a recurrence of the hernia after operation would be represented by a proportion of 15 per cent., but that he may expect, in any case, to be free for some years after the operation from any hernial protrusion.

Indications for the operation.

(1) Policy or expediency; as in the case of a young man who is prevented from entering one of the public services by reason of a hernia, or whose lot is cast in a remote part of the world where he is beyond the reach of efficient surgical aid, and where the circumstances of life are arduous.

(2) When the hernia is irreducible, and other attempts to reduce it have failed.

(3) When the hernia is uncontrollable and the truss causes great annoyance, and where it seems impossible to apply an instrument which will keep the rupture up without at the same time causing distress. In fair-sized inguinal herniæ, with reducible bowel and a portion of irreducible omentum, this is not rarely the case.

(4) After herniotomy in uncomplicated cases.

Indications against the operation.

(1) It is not called for in the majority of the herniæ in children.

(2) Nor in slight degrees of rupture.

(3) Nor in very large herniæ. In the case, for example, of a man with a very large scrotal hernia of long standing, it will be found that so long has the mass of intestines in the rupture been beyond the abdomen that the belly cavity is no longer able to accommodate these extra-ventral coils. The bowel is scarcely to be forced back into the abdomen, and when it is returned the pressure upon the abdominal parietes is such that no measures will suffice to retain it. The majority of the subjects of very large herniæ are corpulent, and have pendulous abdomens. The growth of fat within the belly appears to be a factor in the forcing out of the viscera. An increase in the fatty tissue in the hernial contents renders efficient reduction still more impossible. In immense umbilical herniæ there is no "cavity" in the abdomen into which the enormous mass may be replaced. The place in the abdomen once occupied by the herniated coils of intestine has long since been filled up with fat, or obliterated by the natural adjustment of parts.

(4) It is contra-indicated in old and cachectic subjects, in patients indeed in whom most operations, except those of pressing necessity, are contra-indicated.

2. Irreducible hernia.—In this clinical form the contents of the hernia cannot be returned into the abdomen. In this particular only does it differ in its physical characters from a reducible hernia. It presents an impulse on coughing, and exhibits all the usual physical signs of hernia already described.

The chief causes of irreducible hernia.

(1) *Mere bulk.*—Certain ruptures are irreducible simply from their great size. If the abdomen in these cases be opened after death, the contents of the rupture can be withdrawn from the sac. During life, however, the great size of the hernia makes reduction with one pair of hands impossible. More than that, the involved coils of bowel have been so long prolapsed that their place within the abdomen has been in the meantime occupied. The subjects of very large herniæ (as just remarked) are often corpulent, and there is a considerable growth of fat within the belly cavity. Every available space is occupied, and there is no longer any room in the abdomen for coils of intestine which have left it years ago. The development of fat in the contents of the rupture renders reduction still more impossible.

(2) *Adhesions*.—These present themselves under various conditions: (a) There are adhesions between the sac and its contents. These usually concern the omentum only. It is comparatively rare for the bowel to be adherent to the sac. (b) There are adhesions between the contents themselves. These also usually concern the omentum. A loop of bowel may, however, be fixed in the form of a permanent loop by adhesions. (c) In rare instances adhesions may be solely limited to the sac, and may take the form of bands, hindering reduction and passing from one part of the sac wall to another (Fig. 793).

(3) *Alterations in the contents of the hernia*.—That part of the contents of the hernia which occupies the neck of the sac may undergo a certain degree of wasting. This is best seen in omental hernia, where the wasting of the epiploön about the neck of the sac may reduce it to a mere cord. The mesentery of a loop of gut may exhibit a similar but much less marked atrophy. The fat may entirely disappear from that part of the mesentery which is engaged in the neck of the sac. On the other hand, fat may accumulate in that segment of the contents of a hernia which occupies the fundus, and in this way an obstacle to reduction is effected. This condition is more often associated with the omentum. It may be seen in lesser degree when a coil of the colon occupies a large hernia, fat being developed in the appendices epiploicæ and in the layers of the meso-colon.

In rare examples tumours have been discovered in the bowel or omentum contained in a hernia, and reduction has been prevented by the development of tuberculous glands in the mesentery of the herniated loop.

(4) *Peculiarities in the sac of the hernia*.—Certain varieties of hernia of the cæcum, and less commonly of the sigmoid flexure, are irreducible. (See page 724.) The same applies also to certain ruptures containing the bladder and the ovary. (See page 724.)

Constrictions in the sac, independent of adhesions, and a narrowing and thickening of the neck of the sac may be causes of irreducibility.

The general circumstances of irreducible hernia.—

(1) The irreducibility of a hernia may be, and often is, a *transitory condition*.

(2) Irreducibility is rare in young subjects, and the great majority of the examples are in *patients over thirty*.

(3) Irreducibility is met with most often in femoral, umbilical, and inguinal herniæ, and this order represents the *order of frequency*. It is estimated that 15 per cent. of femoral ruptures, about 10 per cent. of umbilical ruptures, and 2 per cent. of inguinal ruptures are in this condition. Irreducibility is more common in the female than in the male. The commonest example of an irreducible hernia will, therefore, be furnished by a femoral epiplocele in a woman over thirty.

(4) The *symptoms* occasioned by an irreducible hernia vary

greatly. In some instances no trouble is experienced, and the patient may, indeed, be unconscious of the existence of a rupture when the protrusion is small and in the femoral region. On the other hand, the irreducible hernia may give rise to vague digestive disturbances, to flatulence, to colicky pains, to nausea, and to distressing "dragging sensations." Flatulent distension of the transverse colon may be met with in connection with the dragging of adherent omentum. Some patients with irreducible herniæ become quite hypochondriacal.

Other things being equal, irreducibility causes most trouble when it involves inguinal or umbilical hernia, and least trouble when it concerns a femoral rupture. The irreducible hernia tends to increase in size, and is liable to be injured by blows and to become strangulated. Its condition is often aggravated by an ill-fitting truss.

Treatment of irreducible hernia. General measures.—

An irreducible hernia may become reducible after a period of enforced rest in the recumbent position, as shown in patients whose herniæ have returned after such an illness as typhoid fever, or after the long confinement necessitated by a fracture of the thigh. In moderately stout or corpulent subjects reduction has been effected by such strict dieting as will greatly reduce the fat in the body. Irreducible herniæ have been treated by long-continued rest in the recumbent position, associated with a greatly reduced diet, and with continuous pressure over the hernia maintained by an elastic bandage, by a bag of shot, or by an ice-bag. At the same time the foot of the bed is kept raised, and taxis is attempted daily. These measures are in a fair proportion of cases successful, but the result is uncertain, and the process is infinitely tedious. Many patients could not afford to submit to it. It has the one advantage of being free from risk.

Umbilical hernia.—If the patient be corpulent, and if the hernia contain much omentum, reduction may follow upon such measures as will decrease the general weight of the body (diet, exercise, Turkish baths). When these simple means have failed, success may attend the general treatment just described—namely, long-continued rest in the recumbent position, limitation in the amount of food, constant local pressure, and daily taxis.

Very corpulent patients, however, would probably be unable to submit to these measures. In any case the rupture should be supported as thoroughly as possible by a belt. This should be of substantial make, and be provided, over the hernia, with a suitable hollowed pad or metal plate. In large herniæ this plate may have to take its basis or hold from a light pelvic girdle of steel, similar to those used in the common "spinal support."

Inguinal hernia.—Irreducible inguinal hernia—when scrotal, as it usually is—may be treated by the general measures described, or with more effect by the "hinged-cup truss" (Fig. 807). "This consists of two parts, of which one occupies very nearly the position

of the pad of an ordinary truss, and is not concave, and the other forms a scrotal portion, which is united to the former by a transverse hinge. The scrotal part is a three-sided frame of metal, covered with chamois leather and curved to adapt itself to the distended scrotum. The apex of the triangle is downwards towards the perinæum, and to it are attached the under-straps, which are fastened to the side of the truss, just behind the shoulder, as usual. Every pull on the under-strap presses the cup against the scrotum, whilst, by means of the hinge, the movement is hindered from being conveyed to the pad" (Macready).

The truss must be worn night and day. It often will reduce the hernia in two to three weeks. Mr. Macready estimates that 68·7 per cent. of irreducible inguinal herniæ can be reduced by means of this truss. The average time required for the reduction is about fifty days.

The irreducible bubonocoele is treated by a truss with a hollow pad.

Femoral hernia.—The special measure adapted for this form of rupture is the hollow pad truss. The pad in this instrument is a little larger than usual, and is hollowed out to meet the requirements of the case. It is to be worn night and day. It effects the reduction of the rupture in 52·3 per cent. of the cases in which it is employed, but requires in the majority of instances some three years to bring about this end.

Operative measures.—If general or instrumental treatment have failed, or be for one reason or another inapplicable or inexpedient, the question of carrying out the operation of "radical cure" has to be considered.

The circumstances which govern the performance of this operation in non-strangulated cases have already been detailed (page 687). The fact that the hernia is irreducible adds a very substantial argument to the necessity for operation. The rupture probably causes distress, it is liable to become injured or inflamed, and if strangulated is more difficult to deal with than is the reducible hernia when so complicated. The operation has been attended with many disasters and with indifferent results when the rupture has been of great size, and the patient corpulent or advanced in years. These cases, if approached at all, should be approached with



Fig. 807.—The Hinged-cup Truss. (After Macready.)

considerable caution. A small irreducible hernia in a young and healthy subject may be dealt with by operation without delay, but when these conditions are not present a patient preliminary trial should be given to the measures above described.

3. Obstructed or incarcerated hernia.—In this clinical form of hernia the bowel has become irreducible, and is so blocked with fecal matter that the passage of the intestinal contents is arrested. The impulse on coughing is not lost.

Conditions under which it is produced.—Obstruction or incarceration is met with most usually in large herniæ of long standing in middle-aged or aged subjects. These herniæ may be at the time reducible or irreducible. They almost without exception contain colon. The phenomena of a blocking of the bowel with solid contents cannot be expected in the small intestine, although such a condition may be possible in the lower ileum. The hernia most commonly involved is the umbilical form, and next in frequency is a large inguinal hernia containing cæcum or sigmoid flexure.

The conditions leading up to incarceration are usually these. The patient is the subject of constipation—there is a history of flatulent dyspepsia, of indiscretions in diet, of the bolting of food; very possibly the teeth are deficient, or the patient is edentulous; there has been from time to time discomfort in the hernia, and it is very common for the trouble to be preceded by a hearty and indigestible meal. The symptoms are caused by the circumstance that the loop of bowel contained in the hernia has become blocked with fecal matter, and often enough that fecal matter is found to be composed of a bolus of unassimilated food (haricot beans, nuts, pineapple, etc.). There is, indeed, a local stoppage, the position of the gut in the hernial sac lending itself to such an obstruction.

Symptoms.—The symptoms appear gradually, and assume a mild or subacute course. The patient has noticed that the rupture has been gradually swelling, and has become harder and tenser. If it was reducible, or partly reducible, it has now become irreducible. There is constipation, the tongue is coated, the breath is foul, and there is the ill-defined malaise which attends the long retention of fecal matter within the bowel. The abdomen becomes swollen and possibly tense; some colicky pains are noticed, which may attain considerable severity. The appetite is lost. In due course vomiting may appear; but if so it will appear late, will be trifling in degree, and infrequent. The hernia itself becomes painful and often tender, so that it cannot be manipulated. It is found to be unduly large, and to be tense and firm; often it is dull on percussion, and distinctly doughy, and appears to be heavy and solid. At other times it yields a tympanitic note on percussion. It is irreducible, but there is an impulse on coughing, which may be difficult to obtain except at the neck of the sac, and which is always faint. All the symptoms—especially the abdominal pain and the sickness—may be much aggravated by a prematurely administered purgative. Such a purgative may in old subjects be followed by some collapse.

The symptoms may persist for several days; they will pass off when the bowels are relieved. They may, on the other hand, merge into the phenomena of strangulation.

In any case, the symptoms have some resemblance to those of strangulation; but the obstructed hernia is to be distinguished from the strangulated hernia by the following features. In the obstructed rupture the symptoms are of gradual onset; they follow a mild course, and if no hernia existed they would be ascribed merely to obstinate constipation. There is but comparatively little pain, and no marked constitutional depression. The pulse remains of normal fullness, and of scarcely diminished vigour. There may be some slight action of the bowels, and flatus is often passed; vomiting is absent, or is insignificant if present. The hernia retains some impulse on coughing.

Treatment.—Absolute rest in bed, a fluid diet of the simplest and scantiest character, and the application of cold to the hernia in the form of an ice-bag. The degree of cold allowed to reach the skin must be influenced somewhat by the age and condition of the patient. Pain is to be relieved by small doses of opium or morphia. When the pain has disappeared, and when a state of quiet within the abdomen appears to have been secured, an enema may be given. If no discomfort results, this may be followed by an aperient of calomel, cascara, or castor oil. Damage is often done by administering an aperient too soon.

When the bowels have been relieved—or before if the hernia be not tender—gentle taxis may be employed, which may be many times repeated. The patient should remain in bed until all the symptoms have entirely subsided. Another attack may often be averted by ordering a plate of artificial teeth, by attending to the bowels, and by following a simple and suitable dietary.

4. Inflamed hernia.—In this clinical form there is an acute or subacute inflammation of the interior of the hernial sac or of its contents. The condition is simply that of limited peritonitis. The chief causes of inflamed hernia are: The pressure of an ill-fitting truss, blows upon the part, damage due to violent exercise, the arrest of a foreign body in the herniated loop, severe diarrhœa. There is evidence to show that in certain of these cases—perhaps in the majority—the bacterium coli commune is the immediate cause of the localised peritonitis. Inflammation is much more common in irreducible than in reducible herniæ, and in small ruptures than in large. It is especially apt to occur in herniæ containing omentum.

The commonest seat of an inflamed hernia is a small irreducible femoral epiplocele. If exposed the inflamed parts are found to be red and œdematous. The sac will probably contain no fluid, but flakes of lymph will be found upon the inflamed serous membrane. There may, on the other hand, be a considerable effusion into the sac, and but little lymph upon the serous surface. The condition may pass on to suppuration (localised suppurative peritonitis). As a rule the mischief ends in resolution, and the involved omentum or

gut, if not already irreducible, is found to have become fixed to the sac by more or less firm adhesions.

Symptoms.—The symptoms are mainly local. The tumour is irreducible, is tense, hard, firm, and extremely tender. Both in the hernial sac and the region around pain is complained of. If situated in the groin the pain is increased by movement of the limb. The tumour is probably dull on percussion, but still retains an impulse on coughing. When suppuration has occurred, the skin becomes in due course red and œdematous. There is some malaise and a varying degree of fever. There may be nausea or even vomiting, but in any case the latter symptom is slight. The bowels are, as a rule, confined, but the constipation is not absolute. Unlike the incarcerated hernia, obstruction by faecal matter is not a prominent symptom, and when compared with strangulation there are lacking the marked constitutional depression, the incessant vomiting, the abdominal pain, the loss of impulse on coughing.

As a rule, the case ends favourably in three or four days. In exceptional instances the inflammation may spread to the general peritoneal membrane, or the gut may become perforated—if the original lesion be an ulcer of its wall—or may be found to be gangrenous.

Treatment.—Absolute rest in bed, a restricted diet, a little opium to allay pain and arrest peristaltic action, and the application of an ice-bag to the part. Should evidences of suppuration appear, an incision will be called for.

5. Strangulated hernia.—The possibility of strangulation constitutes the great danger to which a patient with a hernia is liable. It is a complication of a serious and often fatal character. But for its occurrence a rupture might be regarded as little more than an inconvenience. The precautions taken in dealing with herniæ are for the most part precautions against strangulation, and the treatment which is applied to reducible and irreducible ruptures owes its elaboration and persistence to the dread of a possible strangulation.

A strangulated hernia may be defined as one in which there is (1) an obstacle to the passage of the gut back into the abdomen, (2) an obstacle to the passage of the intestinal contents, and (3) an obstacle to the passage of blood through the involved loop.

These three factors should be present to constitute a strangulated hernia. If one alone, or two alone, be present, the rupture is other than strangulated. Thus, if there be only an obstacle to the passage of the gut back into the abdomen, the hernia is simply "irreducible;" while if there be an obstacle to reduction as well as an obstacle to the passage of the intestinal contents, the hernia is classed as "obstructed" or "incarcerated."

The mechanism of strangulation.—Numerous theories have been propounded upon this subject, which have been supported and condemned in discourses and discussions of interminable length.

No entirely satisfactory conclusion has been arrived at, and no item of practical value is to be extracted from the exuberant mass of literature with which the whole subject has been burdened. From simple observation, independent of any theory, the circumstances of strangulation would appear to be as follow: A knuckle of intestine, soft, fragile, compressible, and elastic, is thrust through a narrow aperture, the margins of which are practically unyielding. It is forced through the hernial orifice by a pressure acting from the abdominal cavity. The walls of that cavity contract (as in the act of coughing or vomiting, or in numerous muscular efforts), and the bowel is simply forced out. As it is being pressed through the narrow aperture, its shape is altered in such a way that its long axis is more or less at right angles to the plane of the hernial orifice. When, however, it has passed through that orifice, it tends to assume its natural outline, and its long axis becomes parallel to the plane of the said opening. The blood-vessels are pressed upon, and the thin-walled veins are occluded before the arteries. The protruded knuckle of bowel becomes, therefore, engorged and swollen.

It has been shown by experiment that such marked interference with the circulation in the gut leads to meteorism, and by the development of gas within the loop the size of the expelled knuckle of bowel is further increased. There need be no blocking up of the intestine by an accumulation of its contents. As a matter of fact, the bowel in a strangulated hernia is very usually found to be empty. There need be no primary inflammation of the bowel wall. There is no evidence to support the old view that strangulation is due to spasmodic contraction of the tissues forming the neck of the sac.

When strangulation occurs in a non-reduced or irreducible hernia, there is evidence that an additional piece of bowel is protruded, and that it is this accession to the hernial contents which brings about the disaster. An obstructed hernia may become strangulated when the distension of the involved loop has reached such a degree that the circulation of blood in the vessels is interfered with.

Omentum may be strangulated as gut is strangulated, but with infinitely greater difficulty. It is less elastic, less capable of ready alterations in shape, less vascular, and of course unable to exhibit the phenomena of meteorism.

In order to produce the symptoms of strangulation it is not necessary that the lumen of the bowel should be occluded. It usually is occluded, but in Richter's hernia (page 701) it may still remain patent, and yet the phenomena of strangulation may be marked.

The agent of strangulation.—This is sometimes the neck of the hernial sac itself, sometimes the dense tissues which form the margin of the hernial orifice, and which indeed have moulded the neck of the sac. In recent herniæ and in congenital herniæ, which have not been disturbed and which are of not too long

standing, the neck of the sac can hardly form the constricting agent. It can scarcely be said to have an independent existence. After a hernia has existed for some time, the plaits and folds into which the peritoneum is thrown at the neck of the sac become matted together, the tissue immediately external to the neck becomes condensed, and the neck acquires an independent existence. In such a case, if all the structures about it be divided, it still exists. In some old ruptures of large size the neck of the sac may become almost as tough as cartilage. As a result of immoderate taxis the neck has been torn away from the rest of the sac, and has been found around the bowel as an isolated ring. (See page 667.)

That the neck of the sac may prove the sole strangulating agent is shown by cases in which all strangulation symptoms have persisted after *reduction en masse* (page 705), and also by cases in which division of the tissues outside the sac has failed to effect a reduction. That the tissues outside the sac may be the chief or sole agent of strangulation is demonstrated by the old operation of herniotomy, in which reduction was attempted and was often successful without opening the sac.

It is probable that in the majority of inguinal herniæ—especially in those of fair size and long standing—the seat of stricture is the neck of the sac. The old operation of *not* opening the sac met with least success when inguinal ruptures were concerned. In femoral hernia the agent of strangulation, of the “stricture,” is usually outside the sac, and is represented by Gimbernat’s ligament. In umbilical hernia, also, the stricture is usually outside the sac in an uncomplicated case. Herniotomy, without incision of the sac, was attended with the best success when femoral ruptures were concerned.

The gut in a rupture has been strangulated by bands of adhesions which pass from one wall of the sac to another, or it has been so compressed beneath a strip of adherent omentum as to be occluded, or it has been closed by being thrust through a slit in a portion of adherent omentum. It has been stated by some that strangulation may be produced by volvulus or twisting of the protruded loop.

The pathological effects of strangulation.—These may be considered as they involve—(1) the tissues outside the sac; (2) the sac; and (3) the contents of the sac.

(1) *The tissues outside the sac.*—These are usually found to be unchanged. When violent taxis has been applied there may be some extravasation of blood. In cases in which the parts concerned in the hernia have become the seat of inflammation the coverings of the sac may be found to be swollen and œdematous, and the skin to be red and tense. The subcutaneous tissues may be emphysematous. Should suppuration take place, the ordinary evidences of abscess will be present. As a sequel to gangrene of the gut the soft parts over it may become gangrenous. The condition of the tissues outside the sac affords, however, very little certain indication of the condition of the parts within. Thus the soft parts covering the sac

may appear quite normal, and the gut within the sac be found to be wholly gangrenous. On the other hand, the skin may be red and inflamed, and the subcutaneous tissue œdematous, and yet the bowel be found in a fit state to be returned into the abdomen.

(2) *The sac*.—The sac is commonly found to be unaltered. It may, however, be discovered to be inflamed, to be greatly thickened, and to present a wall which is stiff and resisting. A certain amount of fluid is generally found in the sac. It is at first of a pale yellow colour, clear and bright. As the gut becomes more engorged, the serum becomes blood-stained, and later brownish, turbid, or muddy. If inflammation be present it may contain flakes of lymph, or be sero-purulent or even purulent. When the bowel is gangrenous, the fluid in the sac is turbid, brown, and offensive. The serum may, however, possess a faculent odour, without the gut being either perforated or gangrenous; this characteristic being probably given it by the bacterium coli commune (*bacillus pyogenes fetidus*).

The amount of fluid in the sac depends, to a great extent, upon the amount of bowel involved and the degree of strangulation. Macready states that in 33 per cent. of cases of strangulation no fluid is found in the sac. The absence of fluid does not indicate of necessity so tight a strangulation that the venous and arterial currents are immediately and completely stopped. This lack of fluid in the sac may be met with in cases of comparatively slight severity.

The micro-organism most usually found in the sac is the colon bacillus. This is the case in all stages of strangulation, and is independent of the character and amount of the fluid. In fifteen examples of strangulated hernia Bönneken found the bacterium coli commune in the sac in thirteen instances. Tavel and Lanz have not found this micro-organism so frequently.

(3) *The contents of the sac*.—When the intestine is snared the vessels in its walls are compressed, and the veins are narrowed or occluded before the arteries. Thus blood can enter the loop after it can no longer leave it. The gut becomes, therefore, at first bluish, and then purple. It retains its normal lustre, and the individual vessels in its wall are visible. It soon becomes swollen and œdematous, and extravasation of blood may take place in its substance. The gut feels thick and fleshy and tense. The individual vessels are lost; the colour in time changes to reddish-blue or reddish-brown, to a chocolate colour, or to black.

The surface ceases to be smooth and glistening. It becomes dull and sticky, and flakes of lymph may appear upon it.

Finally the bowel becomes gangrenous. It loses its elasticity, and feels soft or doughy. It may remain black, but more usually it is slate-colour or an ashen-grey. Patches of pale grey may appear upon it. It may, on the other hand, become markedly mottled or greenish. The gangrene may affect the whole of the snared loop or a small part. In twenty-five cases noted by Reichel the gangrene was limited to the line of constriction in four cases, to the convexity of

the loop in nine cases, and to both the convexity and the line of stricture in seven cases. In the remaining five examples the whole loop was gangrenous. The gut may be perforated.

Within the bowel in strangulated hernia there is usually nothing found but a little pale yellowish watery fluid, some mucus, and some gas. There may be blood.

There may be evidences of peritonitis in the sac, as shown by frail adhesions, flakes of lymph, or a sero-purulent effusion.

It is by no means always easy to tell whether the gut is still living or is dead; it is still more difficult to foretell that, although damaged, it will recover. If the covering of the bowel retain its lustre, if the vessels in its wall can be seen to empty and refill on stroking, and if the gut bleeds when pricked, it is evidently still living. On the other hand, the lustre of the serous coat may soon be destroyed by inflammation, the individual vessels may be lost to view, and an extravasation of blood may have taken place at the point examined. Mere depth of colour is not an infallible sign of the state of the gut. A loop almost black in colour may undergo complete recovery, while a like loop that is merely a bluish purple may give way after reduction.

The condition of the knuckle of bowel at the seat of stricture merits special attention. There is here to be seen a deep ring-like groove, which may almost completely disappear when the bowel is liberated, but which may, on the other hand, persist for days. A perforation of the bowel may be found at the convexity of the loop, but it is more common at the seat of stricture. It is here due to a linear gangrene at the line of greatest pressure. Under the influence of this pressure the mucous membrane perishes first, then the muscular coat, and last of all the serous tunic. This line of gangrene seldom surrounds the gut entirely; it is most usual or most marked in that part of the loop which belongs to the proximal or upper portion of the intestine, and at the point where the constriction is sharpest—*e.g.* in femoral hernia opposite the edge of Gimbernat's ligament.

If the bowel gives way at this line, the contents of the gut may escape into the abdomen. In more fortunate cases this escape is prevented by recent adhesions.

Any omentum in the sac may be found engorged, or apparently or actually gangrenous. It may be red or livid, or more rarely black. Very commonly the omentum is little if at all affected. It is very evident that the effects of strangulation are more advanced in the bowel than in the omentum, and that the omentum affords a certain degree of protection to the bowel.

As a result of violent taxis, the sac may be found ruptured, blood may be extravasated within the sac, or even in the abdomen; the bowel may be bruised, rent, or ruptured, or there may be a rent in the mesentery.

The symptoms of strangulated hernia. The mode of onset and the general result.—Strangulation may follow upon violent exertion, or the symptoms may develop while the patient is

at rest, or even while asleep. In the cases which are independent of exertion there may be a history of previous lack of condition, of muscular feebleness, of digestive disturbances, or of bowel troubles. A hernia may become strangulated on its very first appearance, as is not infrequently the case in some congenital ruptures. On the other hand, strangulation may appear for the first time in a hernia which has existed for many years. It may be met with in reducible ruptures, or in the irreducible.

Strangulation is most common in the herniæ of adults. It is comparatively rare in children and in old age. It is somewhat more frequent in males than in females. Reducible herniæ are more often strangulated than irreducible, small herniæ than large, and congenital herniæ than acquired.

The patient with strangulation will often say that on several previous occasions the gut has come down, and he has had much difficulty in forcing it back again, and during his efforts to effect this end the rupture has pained him a good deal, and he has felt uncomfortable in his abdomen, and a little faint and sick.

In general terms it may be said that strangulation, if unrelieved, ends in death. A few cases recover after a desperate illness, and after the gut and its coverings have given way and a faecal fistula has been produced. Such examples are, however, very rare.

In some cases of strangulation death follows in as short a time as twenty-four hours; other patients have lived fourteen days. The average duration of life in unrelieved strangulation has been estimated at about eight days. The usual cause of death is peritonitis. In some instances the patient appears to sink from exhaustion or collapse, but this condition usually depends upon an insidious and rapidly-spreading peritoneal infection. That death in nearly every case is due to the septic intoxication which attends peritonitis and intestinal obstruction is very evident.

The symptoms.—In the majority of cases the first symptom noticed concerns the hernia. The reducible rupture is forced down, and cannot be returned, or the irreducible hernia becomes fuller and harder. There is *pain about the neck of the sac*, which is often spoken of as “cutting,” and which varies greatly in intensity. It may increase as the case progresses, but, as a rule, it is gradually lost sight of. The patient feels sick and faint; he is seized with a *pain in the abdomen*. This pain is commonly very severe, is abrupt in its onset, and is of the nature of colic. The man may be bent double. The pain is usually located about the umbilicus—*i.e.* near the centre of the great mesenteric plexus. The pain is at first intermittent, but as the case advances it becomes more fixed.

Vomiting appears early, is a marked and almost constant symptom, is distressing, frequent, and persistent. At first the contents of the stomach are ejected, then the vomited matter becomes bilious, then brownish and ill-smelling, and finally faeculent. Really stercoraceous vomiting is uncommon before the third or fourth day.

The constitutional depression is from the commencement very

marked. A cold sweat breaks out over the forehead, and as time advances collapse becomes more or less pronounced. There is great depression, great loss of strength, the features are sunken, the face is pinched, aged-looking, and terribly careworn. The expression is one of intense distress. The extremities may be livid and the face of a bluish grey tint. The skin is cold and usually moist with perspiration.

The *temperature* is, as a rule, below normal, or at least not raised. The *pulse* is rapid, soft, and small, and later thready and irregular. It may rise to 120 or 140. When a sufficient time has elapsed it becomes evident that there is absolute *constipation*. Not even flatus is passed. The bowels may act once or even twice after the strangulation has set in, the faecal matter coming from the intestine below the part involved in the hernia. In one form of *strangulated hernia* (the partial enterocoele, page 701) the bowels may act regularly throughout. The *tongue* soon becomes coated, is at first white, but afterwards becomes dry and brown.

All appetite is lost and there is an intense *thirst*. The *amount of urine* passed is diminished. As *exceptional symptoms* may be mentioned troublesome eructations, hiccough, cramps in the legs, and retention of urine.

The *abdomen* commonly presents a normal appearance. There may be meteorism, but it is late in developing and is usually slight. As time advances the belly may become very tender to the touch.

The *hernial tumour* is found to be larger than usual, very *tense*, and even hard, dull on percussion, tender, absolutely irreducible, and without impulse on coughing.

The signs of gangrene in the bowel.—There may be no evidences to suggest the onset of gangrene, while, on the other hand, the symptoms may be suggestive or emphatic.

Mr. Macready has well described a case at the period of gangrene. "At this time the patient is worn out with pain and lack of sleep. He is tormented with thirst and stercoraceous vomiting. His eyes are sunken and staring, his face and whole body of a greyish hue. The limbs are icy cold, and, perhaps, covered with a cold sweat. The pulse is weak, and scarcely to be felt. The abdomen is full and distended. It is now that the surface of the tumour becomes of a dusky red colour, tending to black in the centre. On pressure the crackling of emphysema is felt in the subcutaneous tissue. The hernia, which has been tense and elastic, now shrinks, becomes soft, and perhaps undergoes spontaneous reduction. The pain ceases, and sometimes liquid stools are passed. The patient is sensible of some relief, and fondly imagines that he has begun to mend. If, by reason of his strength, he continues to live, the skin gives way, and faeces are discharged at the opening, but otherwise the symptoms return in all their severity, and he dies in collapse."

Variations in the symptoms.—The symptoms vary in different cases. The main bases for such variation are the age of the patient, the state of the health, the nature of the hernia, the

portion and amount of gut involved, and the treatment adopted. In general terms it may be said that recent herniæ cause more severe symptoms when strangulated than do old herniæ, that small strangulated herniæ are more acute than large, and that strangulation of a reducible rupture is usually more serious than that involving an irreducible one. When congenital herniæ are involved the symptoms are, as a rule, more urgent than when corresponding acquired ruptures are implicated.

Symptoms are often less severe when omentum is involved with the bowel than when the gut is alone concerned, the omentum offering some protection probably to the intestine.

In some cases the collapse is sufficiently pronounced to imitate that of cholera ("cholera herniaire" of the French).

Now and then the patient is not aware of the existence of a hernia, and this is especially the case in small femoral ruptures in stout subjects. Frequently the hernia is the seat of little or no inconvenience. The demonstration of the characteristic local signs of strangulation is often impossible in small deeply-placed herniæ.

Strangulated epiplocele may produce symptoms that cannot be distinguished from those attending a strangulation of the bowel. As a rule, however, the symptoms are much less acute and less severe; the pain, the vomiting, the constipation, the constitutional depression are all much less marked. The local symptoms are, on the other hand, usually pronounced.

The existence of strangulated omental hernia, attended by the usual strangulation symptoms, was at one time questioned, but its reality has been placed beyond doubt.

Partial enterocoele or Richter's hernia. Morbid anatomy.

—This form of strangulated hernia (known by the French as "pincement herniaire" or "hernie partielle," and by the Germans as "Darmwandbrüche") has these main features. A part only of the circumference of the bowel is engaged and strangulated in the hernial orifice. The portion snared projects from the surface of the intestine as a small rounded bud-like diverticulum. The groove separating this projection from the rest of the gut is usually well marked. The lumen of the intestine remains more or less free. The strangulated portion of the gut is very apt to become gangrenous.

Richter's hernia is more common in women than in men, and is limited to adults, the average age being fifty-three. It is met with more frequently in the femoral than in the inguinal region, and upon the right side than upon the left. It occurs in old herniæ in preference to those of recent formation, and is more often associated with ruptures that have been reducible than with those that have become irreducible. The tumour, in all the recorded cases, has been very small, varying in size from a nut to a hen's egg. In nearly 50 per cent. of the cases the rupture was neither recognised nor suspected during life. In all these instances death followed.

The segment of bowel engaged is nearly always the ileum, and especially the lower portion of it. A part of the circumference of

the bowel only is strangulated. In the case of femoral hernia the constricting agent would appear to be the crural ring, and in the case of inguinal ruptures, most usually the neck of the sac. The amount of bowel that is strangulated varies. In some cases as much as four-fifths is involved, in others three-fourths, two-thirds, or one-half. Probably in the majority of cases less than one half of the circumference of the tube is held. In many instances the portion strangulated is represented by only one-sixth. The strangulated portion is invariably of circular outline, and forms a prominent projection from the surface of the unimplicated bowel (Fig. 808). The little projection, which tends to become slightly pedunculated, may be no larger than the tip of the little finger, or may reach the size of a cherry.

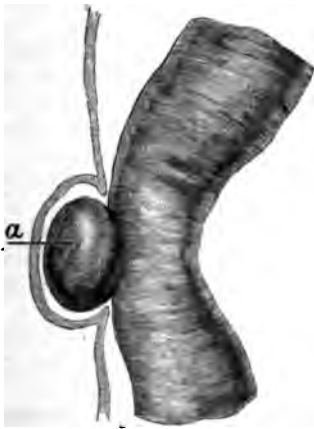


Fig. 808.—Partial Enterocoele or Richter's Hernia.
a, Portion of small intestine nipped in the femoral ring and gangrenous.

The symptoms of this rupture as gathered from an examination of fifty-three cases collected by myself, are as follows:—In about one-third of the examples the symptoms differed in no way from those that attend typical cases of strangulated hernia. With regard to the remaining cases, the symptoms generally were much less severe and pronounced than are those usually attending strangulation. In about one-tenth of these a motion was passed on the first or second day of the strangulation. In the other cases the bowels continued to act from time to time. Sometimes a motion was passed without aperients every day. In other instances the

bowels responded to aperients whenever given during the progress of the case. In the remaining examples, a stool was passed without artificial aid on the third, fourth, fifth, or sixth day of the strangulation.

As regards prognosis, no difference is to be noticed between the cases attended by constipation and those in which the bowels were regular. In three cases there was persistent diarrhoea throughout the whole progress of the trouble.

Vomiting is, upon the whole, less frequent and less severe than in the usual form of strangulation. It may not appear until the second day and may become less urgent as time progresses. In several instances the patient did not vomit more than three times a day throughout the progress of the affection. The vomiting is rarely fæculent.

The tumour being very small is difficult to examine, but when large enough for its physical conditions to be made out it presents no other than the features of an ordinary strangulated rupture.

One striking feature in Richter's hernia is the great difficulty experienced in effecting reduction by taxis. There have been several cases of reduction *en masse*.

Gangrene is met with in over 50 per cent. of all cases, and occurs more frequently in connection with femoral than with inguinal ruptures. It has been found as early as the third day of strangulation.

The **mortality** in Richter's hernia is, as may be supposed, very high, being represented by 62·2 per cent. It is relatively higher in femoral than in inguinal ruptures. The mortality also after herniotomy in these cases reaches a very high figure.

Littre's hernia.—From the variety of strangulated hernia just described must be distinguished that form known as Littre's hernia. This name is applied to a rupture containing a Meckel's diverticulum. The variety is very rare, and it will be apparent that when strangulation takes place the symptoms will have a close resemblance to those met with in partial enterocoele.

Diagnosis of strangulated hernia.—Nothing need be added to what has been already detailed in the account of the symptoms. The main features in strangulation are the constitutional depression, the vomiting, the pain, the constipation, and the absence in the tumour of all impulse on coughing. It will suffice if allusion be made to certain conditions which may reasonably be mistaken for strangulated hernia, namely: (1) Inflammation of a retained testis in an infant; (2) rotation of the testis in young lads—this very acute condition closely resembles the intestinal trouble; (3) peritonitis, or internal strangulation in a patient with an irreducible hernia or a tumour simulating the same; (4) perityphlitis, with a hernial tumour, or depending upon inflammation of a vermiform appendix, which has found its way into a hernial sac.

Treatment of strangulated hernia.—The patient is at once placed in bed, and is made warm by hot bottles and warm blankets: all food by the mouth is discontinued; and if pain be marked, a hypodermic injection of morphia is given. It must be remembered, however, that the symptoms become masked by morphia. Under its influence not only does the pain go, but the vomiting lessens, the pulse improves, the skin becomes warmer, and the patient's countenance loses some of its ghastliness. An ice-bag may be applied to the hernia.

As soon as the patient is comfortably disposed of in bed, taxis should be employed. It must be applied with the utmost gentleness and must not be persisted in. If the gut be not reduced by a manipulation extending over some five minutes in acute cases, and possibly ten minutes in those that are not acute, it is only likely to be damaged by further efforts. The too great use of taxis is certainly more injurious than the too little use. Some surgeons advise, as a help to taxis, a long-continued immersion of the body in a hot bath. This measure, however, is usually very exhausting, and entails an undesirable amount of exertion on the patient's part.

The ice-bag, to which allusion has been made, is not an essential element in the treatment. It may be applied during the time that the patient is recovering from the possible exhaustion of being removed into the hospital or during the time that elapses before the surgeon's arrival. It is usually agreeable to the patient, and strangulated herniæ have disappeared under its use. It should not be persisted with.

Supposing that these preliminary measures fail, the patient should be prepared without delay for operation. When he is under the anæsthetic, one more brief attempt should be made to reduce the hernia by taxis, and if that is ineffectual the operation is proceeded with.

The operation of herniotomy is in itself a very simple procedure, and that the actual amount of cutting—as cutting—is attended with trifling risk is demonstrated by the numerous operations for the radical cure of hernia. The danger is not in the operation, but in the delay. Nothing but evil can result from delay. The mortality of the operation of herniotomy for strangulation is high. It is over 30 per cent. The cases upon which this conclusion is founded are derived from hospital statistics; and the constant complaint in hospital practice is that the cases are not brought for treatment early enough. Hospital surgeons will all acknowledge that better results are obtained in private practice. No great evil is likely to result from operating too soon; death follows an operation that is carried out too late. As a surgical procedure the taxis, when compared with herniotomy, is certainly the more serious and more hazardous operation of the two.

The mortality just named, of over 30 per cent., is not so much the death-rate of the operation as the mortality of delay, and possibly of persistent manipulation.

The details of the reduction by taxis have been already dealt with (page 676). The details of the operation of *herniotomy* require no notice in this volume. It is only necessary to say that in all cases the sac should be opened. There is nothing to be gained by avoiding this precaution. It is necessary to consider certain circumstances connected with both these procedures:—

(A) Circumstances in connection with reduction by taxis.

(1) When the strangulated bowel is reduced by taxis, recovery is by no means invariable. Mr. Bryant has shown that in inguinal cases 3·8 per cent., and in femoral cases 10·5 per cent., die after successful taxis.

(2) Taxis is obviously inadmissible when the coverings of the sac are inflamed, when the hernia concerned has long been irreducible, when the strangulation has been of considerable duration, and when, in a recent case, the symptoms are extremely acute.

(3) A successful reduction may be erroneously considered incomplete when there is much omentum in the sac and only a small knuckle of gut, the reduction of which escapes notice, or when a

small loop of bowel is strangulated in the substance of a large irreducible hernia and slips back without being observed.

(4) Apparent successful reduction may be attended by *no relief to the symptoms*.

This may depend upon the following conditions: (a) Reduction *en masse*; (b) reduction through a rent near the neck of the sac; (c) incomplete reduction; (d) reduction into another sac.

(a) In the reduction *en masse* the sac, together with its contents, is pushed forcibly back into the abdomen; and as the bowel will still be strangulated by the neck of the sac, the symptoms are in no way relieved. In this event the rupture is made to disappear slowly. There is no slipping back and no characteristic gurgle. After the reduction a dull painful tumour may possibly be made out on the abdominal aspect of the hernial orifice. This accident is met with in small and in recent herniæ, and especially in those where the neck is large. It is met with almost exclusively in external inguinal ruptures. In 112 cases of reduction *en masse* collected by Follin and Duplay 101 occurred in the subjects of external inguinal hernia, 2 in direct inguinal ruptures, and 9 in the subjects of femoral hernia. A considerable amount of force is required to effect the reduction of the entire sac, and the accident has been frequently brought about by the patient's own attempts at taxis. As soon as the accident is discovered the hernial orifice should be cut down upon (through the abdominal parietes in most instances), the sac exposed, and the bowel liberated.

(b) This accident is also the result of violence. The rent is usually close to the neck and on the posterior aspect of the sac. The strangled loop is thrust through this rent and into the subperitoneal connective tissue. In such cases the return of the bowel is effected slowly and with continued effort. It does not return with a slip and there is no gurgle. The hernial orifice is found to be still occupied after the supposed replacement and the symptoms persist. This accident is met with only in inguinal hernia and usually in the congenital variety. The treatment is the same as for the previous condition. Cases have been recorded in which the neck of the sac has been entirely torn away from the rest of the sac in the form of a well-defined isolated ring, which still encircled the bowel and still strangulated it, the loop being quite free in the abdominal cavity.

(c) Under certain conditions—as in the very obese—a small inguinal hernia may be so far returned up the inguinal canal as to be no longer perceived externally, although it remains still strangulated and still unreduced.

(d) This accident is met with in connection with interstitial hernia. (See page 719.) There are two sacs with a common neck. The bowel is usually strangulated by the common neck of the sac, and is forced by taxis from one sac into the other, the strangulation at the mouth of the sac being still unrelieved. The sac into which the bowel is forced will be within the abdomen or between the layers of the abdominal wall. This fallacy in reduction has been several times

met with even when the hernia has been exposed by operation. The condition will usually call for an incision, opening the abdominal cavity near to the neck of the sac.

(B) **Circumstances in connection with herniotomy.**

—It should be remembered that the bowel is likely to be most seriously damaged at the part corresponding to the neck of the sac. In dividing the stricture great care must be taken not to damage the bowel in immediate relation therewith. Any attempt to dilate the hernial orifice by means of the finger while the bowel is still in position should be avoided.

When free, the loop of bowel should be pulled down, in order that its condition at the seat of stricture may be ascertained. The handling of the gut must be of the gentlest.

Any omentum found in the sac should be returned when perfectly healthy. If, however, it be suspicious in appearance or adherent or actually gangrenous, it should be freely excised and the vessels in it tied individually with fine silk.

The state of the bowel.—With regard to the bowel the following contingencies may be considered:—

(1) If the gut appears to be *living* and in a satisfactory condition, it should be at once reduced.

(2) If its condition be merely *suspicious or doubtful*, it is better to divide the stricture and to reduce the gut, so that it remains near by the hernial orifice. An iodoform gauze drain should then be introduced into the bottom of the hernial passage and brought out through the skin wound, which will be only partly closed by sutures. It is well known that the injured loop will have little disposition to stray away from the opening into the hernia and that it will probably become adherent in that position. Should the bowel give way, it is probable—as experience has actually shown—that the extravasation will be along the hernial track. The extravasation may, however, take place into the abdomen, but this lamentable accident is the less probable of the two. It is needless to repeat that the hernial passage must be left well open.

(3) If the gut in the hernia be living but *inflamed*, and covered, as it often is, with flakes of lymph, it should be well irrigated *in situ* and then reduced. The flakes of lymph should not be disturbed.

(4) The intestine may show a very small and limited point of *ulceration*, or it may be the seat of a *minute perforation* or of a well-limited and *quite small patch of gangrene*.

These small and well-limited lesions are not common. The ulceration is made evident by the fact that at one limited spot all the coats of the gut, except the serous coat, have been destroyed. This ulceration may be at the fundus of the loop, although it is more common at the part corresponding to the stricture. The perforation here considered will probably be at the fundus of the loop. The perforations at the stricture line are usually considerable.

It is possible in certain of these cases to sequester the damaged part—i.e. the ulcerated or gangrenous part is tucked in, and the

bowel is brought together over it by means of a row of Lembert's sutures (Fig. 809).

The part involved in the perforation may be excised and the opening closed by a double row of sutures. In the same way the piece of bowel about the gangrenous part may be excised and the gap closed by sutures.

All these measures have been carried out with success in isolated cases, but it cannot be too strongly stated that the cases suited for this method of treatment are quite uncommon. It is rare for the destructive process in the bowel to be strictly limited to one quite small part. Then, again, these operations are founded upon the assumption that the bowel around the damaged area is itself sound. If it be so, then these measures are much to be commended; but it is seldom that it will be found in other than a very doubtful condition.

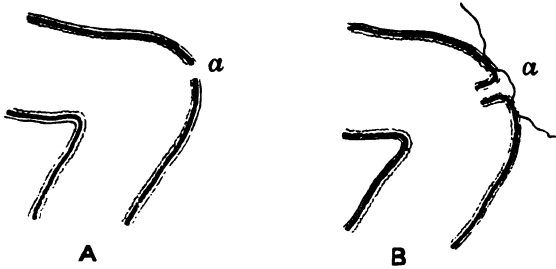


Fig. 809.—A, Ulceration, Gangrene, or Perforation of the Bowel at *a* as a result of strangulation; B, sequestration of the same by suture.

(5) The loop of bowel is *gangrenous* or the seat of an *extensive perforation*. The cases in which these conditions are met with will probably be serious and the trouble be of some days' duration. Since it has become the practice to operate early and to trust less and less to taxis, these cases have become less common.

Considerable differences of opinion exist as to the proper course to adopt in these cases. The procedure that is here recommended is the following:—Leave the stricture undivided, cut into the gangrenous loop when it is still entire, and enlarge the perforation opening when such exists. This should allow of a free escape of feces. If there be not a free escape, then a pair of dressing forceps may be passed up the lumen of the bowel, and an attempt be made by gentle dilatation to secure this free escape. Should it be found that the bowel is absolutely occluded by the stricture—a most rare circumstance—then the stricture must be divided, a portion of intestine must be drawn down and fixed in position, an artificial anus being established.

The following are the reasons for this course:—If the stricture be divided the attachments of the bowel are severed, the peritoneal cavity is opened and is put into communication with the

foul contents of the sac. A protective barrier of lymph will probably have been thrown out about the neck of the sac, and on dividing the stricture this is destroyed. The stricture has ceased to do harm. It has dead and inert bowel within its grasp, and, so far as the bowel is concerned, there can be no object in severing the stricture. In these extreme cases death is threatened, not because a loop of bowel is destroyed by strangulation, but because septic peritonitis is imminent, the septic matter reaching the serous membrane through the overloaded and obstructed intestine. Not only is the bowel overloaded, but its contents are horribly foetid from decomposition. It is very desirable, above all things, that the bowel should be evacuated. This essential in treatment was vigorously urged by Benjamin Travers, who considered that the operation was not complete until the bowel was emptied. This very desirable end can be most safely attained by leaving the stricture undivided. I have never found that a free escape of feces was thereby interfered with. An artificial anus is thus established, and when the patient has recovered from the serious illness attending a strangulated hernia, a second operation should be carried out for the purpose of closing the artificial opening. This will not be attempted until some weeks after the herniotomy.

There are many surgeons who urge that at the time the herniotomy is performed the gangrenous bowel should be resected and the divided ends should be at once united, and the bowel thus rendered entire should be returned into the abdomen and the wound closed. This advice is founded upon the statement that a very high mortality (80·7 per cent., Mr. Kendal Franks) attends the formation of an artificial anus, and that the mortality which attends resection and immediate suture in gangrenous hernia is 48 per cent. The death-rate of secondary resection and suture is placed by Mr. Franks at 38 per cent. These statistics are somewhat misleading. A large proportion of those who die from strangulated hernia die with an artificial anus. The death-rate of 80·7 per cent. cannot be fairly ascribed to the fact that an artificial anus has resulted, nor is it to be inferred that, if these cases had been treated by primary resection and suture, the death-rate would have been reduced to 48 per cent.

The objections to be urged against primary resection and immediate suture are these :—The patient is usually in a desperate state, and is in the worst possible condition to stand a complex and tedious plastic operation. The operation is carried out upon damaged and acutely disturbed bowel. It is not always easy to indicate the exact limit of the gangrene. The operation does not allow of a thorough and immediate evacuation of the bowel above the point of stricture. Should a case occur in a young and healthy subject, in which gangrene had taken place, and in which the patient's state at the time of the operation was satisfactory, then a primary resection may be attempted, but I consider that that operation is not suited for the ordinary run of cases.

Radical cure.—In any instance in which the condition of the bowel allows of its immediate return to the abdomen, the operation may be completed by one of the measures of radical cure, should the patient's general condition allow of this extension of the operation.

The **mortality of herniotomy**, as founded upon hospital statistics in recent years, is over 30 per cent. The death-rate is lowest between the ages of fifteen and forty. Over fifty the mortality rapidly rises with each year of age, and herniotomy is very fatal in the aged. It is also attended with a high death-rate in the very young. The great majority of the patients die of septic infection of the peritoneum. In many the death is ascribed to collapse and exhaustion, but these conditions are little more than the outcome of a sudden and extensive poisoning.

In certain cases (about 5 per cent.) death follows from shock after perforation.

Sequelæ of the operation.—There are cases where, after successful reduction by taxis or operation, acute symptoms still persist. In such instances the following conditions have been found :—

- (1) A strangulation of the bowel exists elsewhere.
- (2) The reduced gut lies within the abdomen *hors de combat* and paralysed. Peristalsis is impossible and all the symptoms of obstruction persist. In such a case, if suspected, the abdomen should be opened and an artificial anus established in the damaged loop.
- (3) The gut has become gangrenous or perforated after reduction.
- (4) It has become kinked or twisted upon itself.
- (5) Acute peritonitis has followed.
- (6) Enteritis may follow, attended by diarrhœa (in which the stools may contain blood), by vomiting, by paroxysmal pain, by a sunken abdomen, and great prostration.
- (7) As remote effects of the operation may be mentioned obstruction symptoms, due to firm adhesion of the once-strangulated loop, to stricture of the bowel following cicatrization after ulcer, and to the fixing of the involved piece of gut into the form of a permanent loop by means of unyielding adhesions.

THE ANATOMICAL VARIETIES OF HERNIA.

Inguinal hernia. Frequency.—This is by far the most common form of hernia. If 100 males exhibit a rupture in the groin, 97·5 per cent. will have an inguinal, and 2·5 per cent. a femoral hernia. If 100 females are so affected, 60 per cent. will have the inguinal variety, and 40 per cent. the femoral.

The greatest number of herniæ are developed during the most active periods of life. In women during the early years of life inguinal hernia is found almost alone; between sixteen and fifty the femoral cases are nearly equal to the inguinal; and after fifty the femoral cases are slightly in excess.

In the male it is observed that up to sixteen inguinal hernia is 6·8 times more common than it is in the female, and from sixteen to fifty it is 10·3 times more common, while after fifty it is 23·8 times more numerous in males than in the opposite sex (Macready).

Herniæ about the groin are often double. This is more often seen in inguinal than in femoral hernia, and in men than in women.

Varieties.—In an inguinal hernia the bowel leaves the abdomen along the inguinal canal (Fig. 810). If, as is common, it follows the

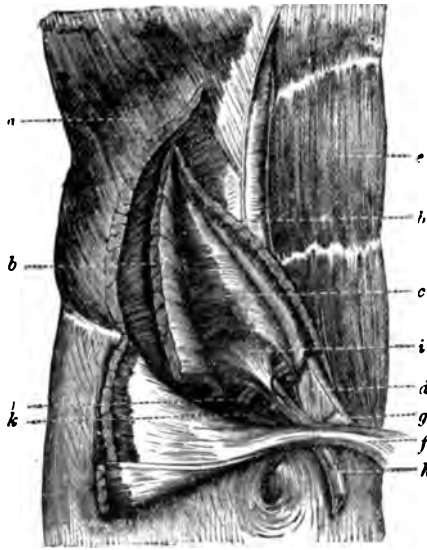


Fig. 810.—Inguinal Hernia.

a, External oblique; *b*, internal oblique; *c*, transversus; *d*, conjoint tendon; *e*, rectus; *f*, Poupart's ligament; *g*, triangular ligament; *h*, cord; *i*, infundibuliform fascia; *j*, epigastric artery; *k*, pubes.

entire line of the canal and escapes at the outer side of the epigastric artery, the rupture is called an *external or oblique inguinal hernia*. If it escapes between that vessel and the border of the rectus muscle it is called an *internal or direct inguinal hernia*. When the protrusion is incomplete and does not extend beyond the external abdominal ring, the term *bubonocoele* is employed. When the hernia descends into the scrotum or labium it is called *scrotal or labial* (Figs. 811 and 812).

The sac of an inguinal hernia may be acquired, or it may be pre-formed and be associated with certain congenital defects in the processus vaginalis of the testis, or in the canal of Nuck.

We shall consider the varieties of inguinal hernia in the following order:—

OBLIQUE INGUINAL HERNIA.

- (a) The acquired form.
- (b) The forms depending upon congenital anomalies. {
- (1) Hernia with undescended testis.
 - (2) Congenital hernia.
 - (3) Hernia into the funicular process.
 - (4) Infantile hernia.
 - (5) Hernia into the canal of Nuck.

INTERSTITIAL HERNIA.

DIRECT INGUINAL HERNIA.

An account will also be given of herniæ of the cæcum, sigmoid flexure and ovary.

In the male 93 per cent. of all acquired herniæ are oblique.

Oblique inguinal hernia. (a) **Acquired form.**—The anatomy of inguinal hernia need not be discussed (Fig. 810). The intestine leaves the abdomen by the internal abdominal ring, follows the length of the inguinal canal, and escapes at the external ring. The internal ring is a little way above Poupart's ligament, at a point midway between the anterior superior iliac spine and the spine of the os pubis. The neck of the



Fig. 811.—Bubonocoele (external or oblique inguinal hernia).

sac is the part between the external and the internal ring. The external ring has usually a triangular figure, with its base at the pubes. It should in a normal subject barely admit the tip of the little finger. It is examined by invaginating the scrotum with the finger, and then passing the digit along the cord until it engages the ring, the nail being kept turned towards the pubes.

In the adult the inguinal canal is estimated to be two inches in length. It is a little longer and a little narrower in the female.

In large scrotal herniæ the mouth of the sac becomes much enlarged, chiefly at the expense of the inner part of the posterior wall of the canal; as a result, the internal abdominal ring, much increased in size, comes to be placed directly behind the external ring. The inguinal canal is in such cases no longer oblique. The rupture when reduced appears to pass back direct into the abdomen.

The bowel lies external to the epigastric artery at the internal ring. In the canal it lies in front of the vas deferens and spermatic vessels, and lower down has the cremaster anterior to it. In the

scrotum the spermatic cord is behind the hernia, and its component parts may be widely separated by it. The testis is below the fundus of the sac, and is distinct from it, except in very large scrotal herniæ, when it is enveloped. Now and then the testis is found on one side of the fundus of the sac, or even in front.

In *shape* the bubonocele is cylindrical and, of course, small in size (Fig. 811). The scrotal hernia of moderate dimensions is cylindrical above and globular below (Fig. 812). A large scrotal hernia is globular or pyriform in shape. Some of these ruptures may attain enormous size. The penis is quite buried, and the skin of the scrotum is excoriated by urine passing over it.



Fig. 812. Large Scrotal Hernia.

Oblique hernia in women.

—This rupture differs in no essential from the corresponding rupture in men. The hernia is seldom of great size; inguinal hernia is much less often labial in the female than scrotal in the male. Less than 4 per cent. of inguinal ruptures become labial. The labial hernia enters the labium majus. It is usually globular in outline and may become pendulous. The labial hernia, as a rule, remains quite reducible and gives very little trouble.

Diagnosis of oblique inguinal hernia.

(1) *From femoral hernia.*

—When the inguinal rupture has reached the scrotum or labium, confusion with femoral hernia cannot exist. Small femoral herniæ can seldom be mistaken for inguinal. Large femoral ruptures, which are mounting up along Poupart's ligament, give rise to most confusion (Fig. 823). An inguinal hernia is seldom mistaken for a femoral, but a femoral rupture is often mistaken for an inguinal.

If the protrusion be reduced, it will be made evident that in one case it disappears at the inguinal canal, and in another at the femoral canal. If the finger be placed upon the spine of the os pubis, any hernia above and internal to it will be inguinal, while that below and external to it will be femoral. The spine of the pubes can be made out in the male by invaginating the scrotum, and in the female by abducting the thigh and rendering tense the adductor longus. If the finger be passed along that muscle, it conducts the digit direct to the pubic spine. The upper edge of even a large femoral hernia does not obscure the fold of the groin. The inguinal rupture starts

from above the line of Poupart's ligament; the femoral from below it. The femoral orifice can be defined by feeling for the femoral artery just below Poupart's ligament. A finger laid along the inner side of the artery will represent the vein, and to the inner side of that is the femoral canal.

(2) *From scrotal swellings.*—The most common errors in diagnosis consist in confusing scrotal herniæ with hydrocele, with an inflamed testicle, with varicocele, or with a solid tumour of the testis. A bubonocoele has been mistaken for a retained testicle. In the ordinary vaginal hydrocele there is no real impulse on coughing, the testis is not to be distinguished, the tumour fluctuates and is translucent, its upper limit can be defined, beyond its upper limit the cord can be made out. The swelling is irreducible. Supposing the rupture to be reducible, the converse holds good in hernia. In a congenital hernia, which has descended into the scrotum, the testis may be as obscured as in a hydrocele. In infants, a hernia containing bowel distended with flatus only is translucent, but not so translucent as is a hydrocele in a subject of like age. The upper limit of a hernia cannot, of course, be defined. A hernial sac *may* contain fluid. (See page 667.)

In congenital hydrocele the testicle is enveloped as in a congenital hernia, and the fluid can be reduced by pressure or on lying down. There may be a good impulse on coughing. There are, however, these distinguishing points. The hydrocele is translucent always, the reduction of its contents is very gradual and totally unlike that of a hernia. When the hydrocele refills, it does so very slowly, and from the bottom. It may take days to refill. The cord is more clearly to be defined above the swelling in the hydrocele than in the hernia.

When a hydrocele occupies the whole of the processus vaginalis, which is closed at the internal ring but is patent below it, the spermatic cord cannot then be felt above the swelling. The physical signs of hydrocele are, however, present.

A hydrocele of the cord is rounded and cyst-like, it fluctuates and is translucent. It usually moves very distinctly on drawing upon the testicle. The upper limit of the swelling can often be well defined. The association of the cord with the tumour is very evident. In hydrocele of the cord there is usually an impulse on coughing.

The differential diagnosis between hernia, on the one hand, and varicocele and solid swellings of the testis on the other, need not be dwelt upon.

(3) *From labial swellings.*—Labial cysts are irreducible, are well defined, are translucent when large, present fluctuation, and are limited above.

Hydrocele of the canal of Nuck is uncommon. The swelling may descend into the labium. It is irreducible, its upper limit is defined, it fluctuates, and may exhibit translucency. Extensive varices of the labial veins and solid tumours of the labium have been mistaken for hernia.

(b) **Forms depending upon congenital anomalies. (1) Oblique inguinal hernia with undescended testis.**—

This association is not uncommon. The testis may be entirely retained or—as is more usual—may occupy some part of the inguinal canal. The testis so placed is very often soft and atrophied, and is occasionally hyperæsthetic. In seventy-nine cases of hernia associated with undescended testis collected by Macready the testis and the hernia came down together in twenty-four instances. In nine cases the testis descended before the hernia, and in no less than forty-six cases the hernia came down before the gland.

In the *treatment* of this condition in infants under one year the parts may be left alone. The rupture will probably do no harm from this neglect, and the testis, if undisturbed, may complete its descent. Beyond that age a truss should be worn, and if the truss can keep up the hernia without at the same time keeping up the testis, it is well. Mr. Macready makes the following remarks upon this subject:—“The surgeon, when adjusting a truss, may altogether neglect the testicle. The notion that a truss may cause atrophy of a belated testis has probably arisen from the circumstance that these testes are generally small and ill-developed. If the testis has a tendency to descend into the scrotum, the truss is powerless to prevent it, and the surgeon need be under no apprehension that the instrument will interrupt the course of nature.”

Many of these cases are well suited for the operation of “radical cure,” the atrophied testis being at the same time removed.

(2) **Congenital hernia.**—When the testis descends into the scrotum in the course of normal development, it is accompanied by a pouch of peritoneum called the *processus vaginalis* (Fig. 813, A). This process soon becomes shut off from the general peritoneal cavity. It becomes, indeed, occluded at two places—namely, just above the epididymis and at the internal abdominal ring. The membrane below the lower of the two points of occlusion becomes the *tunica vaginalis* (Fig. 813, D). Above or beyond the upper point is the general peritoneal cavity. The portion of the membrane between these two points wastes and is soon merely a fibrous cord (Fig. 813, D).

Should any portion of the isolated tube between these two points remain patent, and should serous fluid accumulate in the unobliterated segment, a *hydrocele of the cord* results.

Should the *processus* be closed only at the upper of the two points, then there is left a very large *tunica vaginalis*, which extends up to the internal ring, and which, if distended with fluid, may lead to a *peculiar form of vaginal hydrocele* (Fig. 813, c).

Should the *processus* be closed at the lower point only, then there is produced a pocket or pouch of peritoneum extending from the great serous cavity down to the upper end of the testicle. This pouch is called the *funicular process* (Fig. 816). It is quite separated from the *tunica vaginalis*. A hernia into this pouch or *diverticulum* is called a hernia into the *funicular process* (page 716).

Should the process remain entirely unclosed, it exhibits the

condition of the unaltered processus vaginalis. The testicle lies at the bottom of a pouch which opens direct into the peritoneal cavity (Fig. 813, B).

Serous fluid collecting in this pouch constitutes a *congenital hydrocele*, and hernia, with this pouch for its sac, is termed a *congenital hernia* (Fig. 814).

The term "congenital" is misleading. The patient but very rarely exhibits the hernia actually at birth. The rupture is, of course, usually met with in early life. It is apt to appear abruptly and the condition of the sac allows of the almost sudden formation of a *scrotal hernia*. Herniæ which appear suddenly in youths are very usually of the

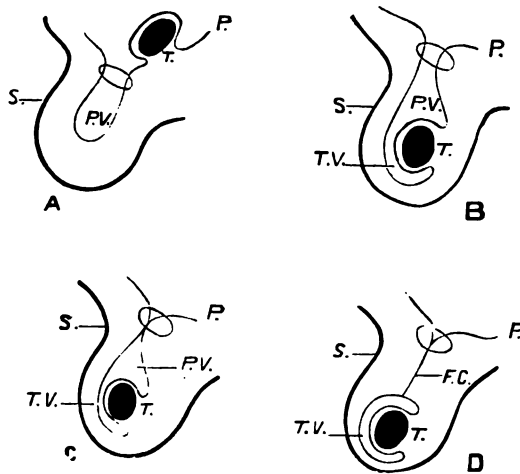


Fig. 813.—Descent of Testicle. The inguinal canal is represented by a ring. (From Cunningham's "Manual of Practical Anatomy," vol. I., 1893.)

P, Peritoneum; T, testis; S, scrotum; P.V., processus vaginalis; T.V., tunica vaginalis; F.C., fibrous cord.

congenital type. A patent processus vaginalis may exist without a hernia and, indeed, the processus is often quite patent at birth.

Congenital hernia is not very common. Macready estimates that it forms only 8 per cent. of the whole number of inguinal herniæ.

If the processus vaginalis become—subsequent to the formation of the hernia—occluded just above the epididymis, the congenital hernia may change to a hernia into the funicular processes.

The neck of the sac of a congenital hernia is long and very often narrow. The external abdominal ring, moreover, may be quite small. These facts explain the difficulty which is often experienced in reducing these ruptures when strangulated.

Constrictions in the sac are quite common, especially one just above the testis. By means of certain of these constrictions the "hour-glass sac" is produced.

The interstitial hernia is usually a variety of the congenital hernia (page 719).

The *general characters* of a congenital hernia are the following:—



Fig. 814.—Sac of Congenital Inguinal Hernia.

It is met with early in life. It is apt to appear suddenly, or, at least, to develop quickly, and to soon become scrotal. The testis lies at the lower and posterior part of the hernial tumour and is quite enveloped in it, as is the case with the testis in a common hydrocele. This obliteration of the testicle is a marked feature of the rupture. Congenital herniæ have usually the outline of a common hydrocele. Some are, however, more globular (Fig. 815). These herniæ are especially liable to become strangulated, and, when strangulated, are more difficult to reduce than the acquired rupture. They are, on the other hand, more readily cured by trusses.

(3) **Hernia into the funicular process.**—The anatomical condition leading to this form of rupture has already been detailed (page 714). The depth of the pouch or diverticulum varies—i.e. it may not be wholly patent as low down as the tunica vaginalis.

The *general characters* of the hernia are those of the congenital hernia, with these points of difference: It may appear for the first time at a later period of life. The testis is beyond the fundus of the sac, and is quite separate and distinct from it (Fig. 816). The hernia is seldom so large as the congenital form, and assumes, as a rule, a cylindrical shape (Fig. 817). It will be evident that a hernia into the funicular process is not always easy to distinguish from an acquired hernia, especially in subjects who have passed the period of childhood.

(4) **Infantile hernia.**—This comparative-ly rare variety of hernia is not well named. It is

by no means peculiar to infants, and, indeed, the majority of the cases have been met with in adults. The hernia can lay claim to no



Fig. 815.—Large Congenital Hernia in a Child.

distinctive clinical features. Its peculiarity lies in the relation of the sac to the processus vaginalis or tunica vaginalis (Fig. 818). Roughly speaking, it may be said that the sac descends behind the processus or tunica vaginalis, and bulges into it, so that on cutting down to the protruded gut, from in front, three layers of peritoneum are met with, the first two belonging to the processus vaginalis, and the third representing the hernial sac. It thus happens that an infantile hernia remains unrecognised until it is exposed by operation. This form of rupture has been fully investigated and explained by Mr. Lockwood. In nearly all the specimens described it is to be noted that the tunica vaginalis had a cavity of considerable magnitude which extended upwards to the neck of the sac. Indeed, a capacious tunica vaginalis would appear to be essential to the perfect manifestation of this form of hernia.

Two principal forms of infantile hernia are recognised.

The rare form.—In this variety an incision made over the tumour soon exposes a serous sac, which proves to be a large processus vaginalis or a tunica vaginalis, patent as far as the internal ring. The testicle is exposed. Hanging free in this capacious tunica vaginalis is a hernial sac. The sac is quite free of the tunica vaginalis, except at the neck, where it is intimately connected with it.

The common form.—Here the tunica vaginalis also contains the sac, and is closed around it at the neck; but unlike the previous form the posterior wall of the tunica vaginalis is intimately united with the back wall of the sac in its entire length. In continuation with this attachment a serous fold (plica vascularis) descends from the fundus of the sac to the testis. Indeed, the hernial sac, the plica vascularis, and the testicle all appear to be attached to the wall of the tunica vaginalis by a common fold



Fig. 816.—Hernia into the Funicular Process.



Fig. 817.—Hernia into the Funicular Process.

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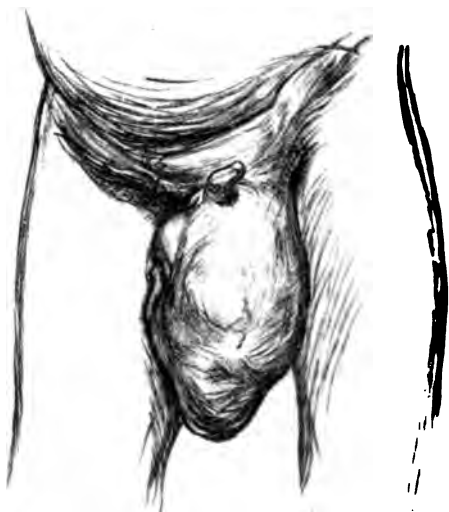


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that would be found a hernial sac. It would not be hanging free as in the previous form, but would appear to be bulging forwards through the posterior wall of the tunica.

The formation of the sac.—Mr. Lockwood has explained this by reference to the descent of the testis. The gubernaculum testis—which plays so important a part in this descent—passes downwards to the scrotum, perinæum, and pubes. If followed upwards it is found to become closely connected with the processus vaginalis (behind and within which it lies), and above the testis it is found in a fold of peritoneum called the plica vascularis. This fold contains the spermatic vessels. Beyond the fold the fibres of the

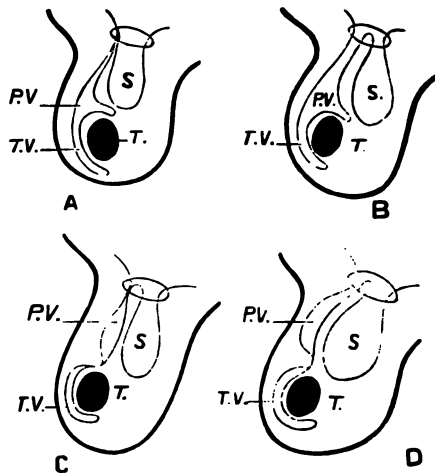


Fig. 818.—The Condition of the Tunica Vaginalis in Infantile Hernia. (Cunningham's "Manual of Practical Anatomy" vol. I., 1893).

A, Processus vaginalis closed above; B, processus vaginalis open throughout; C, processus vaginalis closed above and below but open between; D, processus vaginalis closed below but open above. Lettering as in Fig. 813; S, hernial sac.

gubernaculum are lost in the mesentery of the cæcum and ileum or in the sigmoid meso-colon, and they are to be traced also to the peritoneum lining the iliac fossæ.

In many specimens of infantile hernia examined, Mr. Lockwood was able to demonstrate traces of the gubernaculum extending upwards from the epididymis to the fundus of the sac, and even to the neck of the sac. Mr. Lockwood has shown that if traction be made upon the gubernaculum in a fœtus, whose testis is not yet descended, not only do the processus vaginalis and testis move downwards, but also the peritoneum lining the posterior wall of the abdomen, and with it, if need be, the cæcum or the attachments of the sigmoid flexure.

In infantile hernia the gubernaculum appears to have accomplished more than is normally intended, and to have drawn down

two processus vaginales instead of one. The extra process becomes the sac of a hernia.

As regards the actual condition of the tunica vaginalis, Mr. Lockwood considers that it may be met with in one of four conditions. The tunic may be patent as high up as the internal ring, and, therefore, unduly capacious (Fig. 818, A). The processus vaginalis may be entirely patent (Fig. 818, B). It may be closed below only—funicular process—(Fig. 818, D). It may be closed above the testis and at the internal ring, but patent between. In such a case a small serous sac, or an encysted hydrocele, is found in front of the hernia, and is cut into before reaching the sac (Fig. 818, C).

(5) **Hernia into the canal of Nuck.**—A process of peritoneum accompanies the round ligament in the female foetus. It is usually found obliterated at birth. It may remain open for many years, or even for a lifetime. It is then called the canal of Nuck. This canal is long and narrow, and may contain an oblique inguinal hernia of the ordinary type. It is noteworthy, however, that the canal, when met with, is more often found unoccupied than the seat of a rupture. In the newly-born the canal has been found patent in some 20 per cent. of the bodies examined. With each decade of life it becomes rarer and rarer to find it patent, and in bodies of all ages it is estimated to exist in only some 10 per cent.

It would appear that only in quite a few of these cases does a hernia occupy the patent process.

The chief interest associated with a patent canal of Nuck is in connection with interstitial hernia (*see below*) and hernia of the ovary (page 724).

Interstitial hernia.—In this remarkable form of rupture there is in addition to the usual sac of a hernia a second sac or diverticulum, which extends between the layers of the abdominal parietes. This additional sac leads out of the original sac, and the two have a common mouth by which they communicate with the abdominal cavity (Fig. 819).

With few exceptions the original sac consists, in the male, of an open processus vaginalis, as shown in the diagram (Fig. 819); and in the female it would appear to be usually associated with a patent canal of Nuck. In the male the testicle is commonly retained or arrested.

There are three **varieties** of this hernia described: (1) The additional sac is between the fascia lining the abdomen and the parietal peritoneum; (2) it is between the internal and external oblique

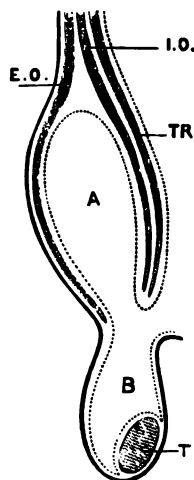


Fig. 819.—Diagram of Interstitial Hernia. (Second variety.)

A, Additional sac; B, original sac; E.O., external oblique; I.O., internal oblique; TR, transversalis.

muscles (Fig. 820); (3) it is between the external oblique muscle and the skin. Of these three varieties the second is by far the most common. The first variety is quite rare, only some twenty-five examples having been collected.

The mode of production of the interstitial hernia is a matter of much dispute. It has been assumed that the additional sac may depend



Fig. 820.—Case of Interstitial Hernia of the second variety. The testis on the right side was undescended. The additional sac (A) reached to the anterior superior iliac spine. The patient, a man of forty-five, was under the author's care, and the hernia was cured by excision of the sac.

upon some congenital abnormality in addition to that usually evident in the arrested testicle and open processus vaginalis. It has been supposed, on the other hand, that the formation of the second sac has depended upon a narrow external ring, the bowel extending in the direction of least resistance. Finally, there are those who maintain that the adventitious sac may result from persistent and ill-directed attempts at reduction.

The first variety.—This form is often known as the *properitoneal hernia*. The original sac is usually in the scrotum, and of fair size. The second sac may be between the pubes and the bladder (*hernia inguinalis antevesicalis*), or—as is much more common—in the iliac fossa (*hernia inguinalis intrailiaca*).

In each instance the sac is found lying in the subperitoneal tissue. An example or so of a femoral hernia and of a direct hernia with a diverticulum between the pubes and bladder has been recorded; the diverticulum being derived from the original sac.

The present variety of interstitial hernia has seldom been recognised during life or before operation.

In the antevesical form there is never any ventral swelling to indicate the existence of a second sac. In the intra-iliac form there is also, as a rule, no external evidence of an additional sac, although in a few cases a swelling has been discovered in the iliac fossa. When strangulation occurs it usually takes place at the common mouth, but it may occur at the mouth of the additional sac. The strangulated bowel may be reduced, still unrelieved, from the original sac into the second sac, and this deceptive circumstance has occurred when the parts have been exposed by operation.

The scrotal sac may contain non-strangulated omentum, and the hidden sac strangulated bowel. This hidden sac may be overlooked.

The second and third varieties.—These varieties are

known as *intraparietal hernia*. Mr. Macready has collected 163 cases from the Truss Society's records. He estimates the relative frequency of these ruptures at about 1 in 1,000 cases of inguinal hernia in males, and at about 6 in 1,000 cases in females. In 73 per cent. of the male cases there was some abnormality of the testicle. In 67 per cent. the testis was retained or only partially descended.

Out of the 163 cases, 129 were males and 34 females.

In male subjects the hernia is most often met with in infants, although it has been noted at all ages. In female subjects the greater number of cases are met with between the ages of twenty-five and forty-five. In both sexes the rupture is about twice as common on the right side as on the left.

So far as the clinical features are concerned, there is in the intra-parietal hernia a ventral swelling, which presents characteristic features. (See Fig. 820.) The original sac is usually small, and seldom enters the scrotum. The additional sac forms a flattened oval tumour, which mounts up towards the loin, parallel to Poupart's ligament. This tumour contains bowel or omentum when distended, and is evidently connected with the external abdominal ring to which it may be traced.

In some cases the sac has been so large as to reach to the ribs, or it has become pendulous and has hung over the thigh.

The second of the three varieties is the most common form of interstitial hernia. The muscles between which the sac lies are usually atrophied, and that wasting may reach an extreme degree. In the hernia of the third form the external ring may be very large, and indeed it may appear that the anterior wall of the inguinal canal is absent.

The intraparietal hernia may be reduced, as a rule, and may be retained by a special truss with a large pad for the ventral swelling when such is manifest.

Direct inguinal hernia.—This rupture forms only 7 per cent. of inguinal herniæ.

It is, therefore, comparatively rare. The sac is always acquired, and protrudes at the semilunar line, between the epigastric artery and the edge of the rectus muscle. It enters the lower part of the inguinal canal, and escapes at the external ring. The mouth of the hernia is formed at the expense of the posterior wall of



Fig. 821. — Direct Inguinal Hernia.

the inguinal canal. The spermatic cord lies, as a rule, on the outer side of the sac.

Any further account of the anatomy of this hernia need not here be given.

Clinical features.—The direct hernia is a hernia of adult males, most of the examples being met with between the ages of forty and fifty. It may appear suddenly, but in the great majority



Fig. 822.—Hernia of the Cæcum. The cæcum occupied a diverticulum from the sac of an inguinal hernia. (From a case under the author's care.)

of instances its development is gradual. The hernia is usually small. It may be met with as a bubonocoele (Fig. 821). It seldom becomes scrotal. When in the scrotum it appears as a globular swelling, which has a vertical position, and which leans towards the median line, which it may overlap.

Although the hernia is usually small, the aperture in the abdomen is relatively very large. When the rupture is reduced it returns direct into the abdomen. The aperture is readily to be felt, and appears as a simple gap in the abdominal wall. At its lower part the finger encounters the os pubis, and at its inner side the edge of the rectus. The hernia is a little more common on the right side than on the left, and may be double.

It is usually reducible, but may become strangulated, an accident to which it is less liable than the oblique hernia.

When the protrusion descends into the scrotum, the characters of the rupture are usually lost, and it is difficult to distinguish it from the ordinary scrotal hernia (oblique inguinal) (page 711).

Treatment.—The rupture usually requires a rat-tailed truss. "If the opening into the belly is very large, it sometimes happens that the rupture escapes at the inner side of the pad. To obviate this a truss called a 'forked tongue' was devised by Mr. Kingdon, which differs from the 'rat-tail' in that the pad is carried inwards for a considerable distance, and forms a tongue, which is fixed by a thong to the cross-strap near the anterior superior iliac spine of the sound side" (Macready).

Hernia of the cæcum.—The cæcum may be found in the sac of an inguinal, femoral, or umbilical hernia. It is most commonly met with in right inguinal ruptures. It has been found in a left inguinal hernia, and even in a left femoral. In these examples the cæcum is unduly mobile, and is more or less free in the abdominal cavity. It descends into the hernial sac just as any other coil of bowel may descend. The rupture in which the cæcum is found in these instances is provided with the ordinary sac, and the strange error which led to the statement that "in hernia of the cæcum there is no sac" has long since been exposed. In the case represented in Fig. 822 the cæcum occupied a diverticulum on the outer side of the sac of an oblique inguinal hernia. In the scrotal tumour were coils of the lower ileum.

The cæcum, when in a hernia, is apt to become incarcerated or obstructed. It is not especially prone to become adherent. In umbilical hernia the cæcum is most commonly met with in the congenital variety (page 727).

The *appendix vermiformis* may be the sole viscus found in a hernia. I have met with it alone in both inguinal and femoral ruptures. It may become adherent to the hernial sac, and may, while so adherent, become inflamed and set up the symptoms of acute perityphlitis. I have had occasion to remove an adherent appendix from the inguinal canal by operation. When alone in a hernia the little process is not difficult to identify.

Congenital cæcal hernia.—This term is applied to certain right inguinal ruptures of the "congenital" type which contain the cæcum. The sac, as indicated by the term "congenital," is formed of the patent processus vaginalis. It has been demonstrated that in this form of hernia the cæcum is drawn into the sac by means of the gubernaculum. It has been already pointed out (page 718) that the gubernaculum, when traced upwards beyond the testis, is found to attach itself to the meso-cæcum (on the right side) or to the peritoneum lining the iliac fossa. We have seen, in dealing with infantile hernia, what an excessive action of the gubernaculum may effect in dragging down a second sac of peritoneum. In this cæcal hernia the gubernaculum drags down bodily the peritoneum which

lines the iliac fossa, and actually brings it into the hernial sac. The cæcum comes with it, and bears exactly the same relation to the hernial sac as it bore to the parietal peritoneum. If the cæcum was free in the abdominal cavity, then it lies free in the hernial sac, which is complete in all parts. If it was attached by a meso-colon, then that meso-colon is found to be coming off from the posterior wall of the sac (which wall is merely displaced parietal peritoneum). If the commencement of the ascending colon have no meso-colon, then the bowel is found to be adherent to the posterior wall of the sac, and that part of the sac is found to be more or less wanting. The cæcum is not always attached to the posterior part of the sac. It may be connected with its anterior or its outer part. In any such case the sac is incomplete where the bowel is attached, some part of the gut being uncovered by peritoneum.

In these congenital herniæ traces of the gubernaculum have been found without the wall of the sac.

The herniæ associated with imperfect sacs are irreducible. The rest are readily reduced.

Hernia of the sigmoid flexure.—The sigmoid flexure, forming as it does a long free loop, may find its way into almost any hernia. It is most common in a left scrotal hernia. It occurs in femoral ruptures of the left side, and this loop of bowel has been found in both inguinal and femoral ruptures on the right side. Herniæ containing a considerable part of the sigmoid flexure are apt to become incarcerated, and the protruded bowel is also prone to become adherent.

A congenital hernia of the sigmoid flexure may be met with in the left inguinal region. It is produced in precisely the same way as the congenital hernia of the cæcum. The sac may be complete or incomplete, the bowel and the peritoneum with which it was connected having been simply displaced downwards into the hernial sac.

Hernia of the ovary. (1) **Congenital form.**—This hernia of the ovary is met with at all ages, but it is rare, except in infants. It is always inguinal, and associated with a patent canal of Nuck. It is a little more common on the left side than the right, and it may be double. The ovary is commonly found alone in the hernia, but it may be associated with protruded bowel.

The ovary may be just inside the external ring, or just outside it, or more rarely in the labium. In infants the ovary is reducible in about half of the cases. In adults it is nearly always irreducible. In infants this hernia is often only a temporary condition, the organ returning after a while into the abdomen. In hernia of the ovary the uterus is usually found displaced, and is often imperfectly developed, especially when the hernia is double.

In infants the ovary can be recognised as a little rounded body, which is solid, and which slips about when pressed upon. It is attached to a cord, which can be traced to the internal ring. In adults the tumour is less readily recognised. It forms a solid mass,

a little larger to the feel than the normal ovary. It is apt to enlarge and become tender during menstruation, although, in my experience, this is by no means invariable. It is commonly hyperæsthetic. It is often mistaken for adherent omentum.

The *treatment* is simple. The ovary should be exposed. If it be normal, and can be readily replaced, it should be reduced. If it be abnormal, or if reduction be difficult or considered undesirable, the protruded organ should be removed.

(2) **Acquired form.**—The ovary has been found in ordinary inguinal and femoral ruptures, and also in vaginal and ischiatic



Fig. 823.—Femoral Hernia (mounting upwards).

herniæ. In these cases it has entered the hernial sac merely as a prolapsed organ, and is found associated with protruded bowel or omentum.

Femoral hernia.—In this form of rupture the gut leaves the abdomen through the femoral ring, and descends to the thigh along the crural canal. Next to inguinal hernia, femoral hernia is the commonest form of rupture. It is more common in women than in men. The relative proportions of inguinal and femoral herniæ in the two sexes are alluded to on page 709.

Femoral hernia is always acquired. It is rare before twenty. It is, however, met with in children, and is in them more common in girls than in boys.

Anatomy.—The hernia in its descent first of all takes a vertical course. At the lower end of the femoral canal it bends forwards, and presents under the skin. When of moderate size, it forms a globular

swelling just below Poupart's ligament, and at the site of the saphenous opening. The neck of the swelling is external to the spine of the os pubis. To the outer side of the tumour, and separated from its neck by about the width of the finger, is the femoral artery. Close to the outer side of the neck of the hernia is the femoral vein. The spermatic cord lies above the anterior border of the femoral ring, and the epigastric artery skirts its upper and outer part. The little pubic branch of this artery passes round the ring to ramify over Gimbernat's ligament. In one case in three and a half the obturator artery arises from the epigastric. Out of 101 cases where the vessel so arose it reached its destination in fifty-four instances by passing along the outer side of the crural ring—a position quite free from danger in herniotomy. In thirty-seven cases it passed backwards across the ring, and in ten instances around its inner border. When in the last situation it could hardly avoid being wounded in herniotomy.

The coverings of a femoral hernia are detailed in all anatomical works.

A femoral hernia is usually small, and when small its long axis is vertical. If it increases in size it is apt to overlap the femoral vessels and to mount up obliquely on the line of Poupart's ligament (Fig. 823). It is probable that the movement of the thigh in flexion of the hip gives it this inclination. Even when large a femoral hernia will not mount up above Poupart's ligament, nor will it ever quite obscure that structure. It is the large and oblique form of femoral hernia which is apt to be mistaken for an inguinal rupture (page 712). Even when large the hernia tends to retain its globular shape.

Occasionally a large femoral hernia will extend down the thigh.

While the sac is small it is usually loosely attached, and may be reduced with the contents. Many cases of reduction *en masse* have been recorded in connection with strangulated femoral hernia treated by prolonged taxis. In such instances the bowel is reduced, still strangulated by the neck of the sac.

The sac—especially when large—may present one, two, or even three diverticula, and so exhibit a lobed appearance. One of such diverticula may ultimately exceed in size the original sac.

Clinical features.—The femoral hernia forms gradually and very often painlessly. It causes, on the whole, much less distress than the inguinal hernia. The rupture is often ignored by patients for years. They may be conscious of a lump in the groin; but as it gives them no trouble, they take no steps for its relief. Very often, indeed, small femoral herniæ are overlooked and this is especially the case in stout women. There are not a few instances in which the abdomen has been opened for acute intestinal obstruction and the case found to be one of strangulated femoral hernia.

There is often an enlarged gland over or about the hernial sac, which helps to complicate matters.

Femoral ruptures are more often strangulated than inguinal, are more often strangulated on their first descent (or what is considered to be their first descent), and are in any case more difficult to reduce.

Irreducible femoral enterocele is rare, but irreducible femoral epiplocele is very common.

Femoral herniæ are frequently inflamed, especially when they contain omentum, but are very rarely incarcerated. When strangulation has occurred, it is found that gangrene of the gut and artificial anus follow more often in femoral than they do in inguinal herniæ.

The *diagnosis* between femoral and inguinal hernia has been already alluded to (page 712).

Among the affections mistaken for femoral hernia are enlarged glands, varix of the saphena vein, abscess, and such growths as lipomata. A gland enlarged by malignant disease—*e.g.* melanotic sarcoma—placed well within the saphenous opening, and in a stout person, may present a close resemblance to an omental hernia, especially if the primary growth be ignored by the patient.

A varix of the saphena vein has a faint impulse on coughing, becomes larger when the patient stands erect, and can be, in a way, reduced by pressure. These points of resemblance to hernia are more apparent than real, and if the part be well exposed, the error in diagnosis should never occur.

A psoas abscess presenting in the groin below Poupart's ligament has a distinct impulse on coughing, and is larger when the patient stands up. It presents, however, to the outer side of the femoral vessels, and fluctuation can be obtained by pressure above Poupart's ligament.

Some very rare instances have been recorded of a femoral hernia descending external to the vessels, or passing behind the crural sheath, or making its way through Gimbernat's ligament.

The sac of a femoral hernia may be distended with fluid producing a hydrocele of the sac.

Umbilical hernia.—Three varieties of this rupture are met with—namely: (1) the congenital form, (2) the infantile form, (3) the umbilical hernia of adults.

(1) **Congenital umbilical hernia.**—There is a time in the development of the embryo when the intestines are outside the future abdomen. At the third month the viscera become enclosed by the visceral plates, and the cavity of the abdomen takes on its permanent form. The closure is last completed about the site of the umbilicus, and the cæcum and lower ileum are among the last coils of the bowel to be enclosed.

In a congenital umbilical hernia this closure has not been complete. Some part of the intestinal tube still remains without the abdominal cavity. As Malgaigne says: "The hernia here does not merit the name, for it is concerned not with viscera which have escaped from a cavity, but with viscera which have never entered it." The hernia is, therefore, always congenital, in a precise sense. The child is born with it, and it is (or may be) noticed at birth. It is estimated that among newly-born children this hernia is met with in 1 in 5,000 cases (Lindfors).

The size of the rupture varies greatly. In the *most extreme cases*

the abdominal cavity is unclosed from the sternum to the os pubis, and the walls of the cavity are more or less wanting. This condition—known as eventration or ectopia viscerum—is not compatible with life, and possesses no interest in practical surgery.

In cases of moderate degree the hernia appears as a globular swelling at the root of the umbilical cord. The cord usually enters the summit of the tumour, more rarely one side of it. The hernial sac—such as it is—is introduced among, and is covered by, the tissues of the cord, which are, indeed, expanded over the swelling (Fig. 824). Very often the coverings of the hernia are so thin and transparent

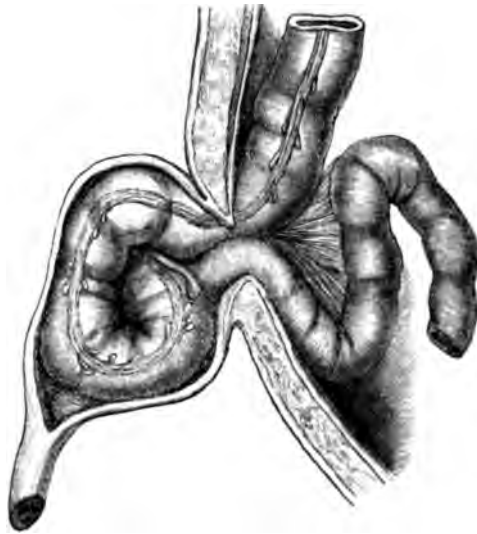


Fig. 824.—Congenital Umbilical Hernia, containing the cæcum. (Albert.)

that the contained viscera can be seen. The sac usually contains the cæcum and some coils of the lower ileum. There may be a Meckel's diverticulum within it. In some of the larger herniæ the stomach, the spleen, and even a part of the liver may be found.

The sac may burst shortly after birth, in which case the infant dies rapidly of peritonitis. The sac may, on the other hand, become dry and opaque, may slowly slough, and expose the peritoneum covered with a thick layer of lymph. When this occurs, the child usually dies of peritonitis, although in a few instances recovery has followed spontaneously. In some examples, especially when the sac is more substantial than usual, symptoms of strangulation appear almost directly after birth, and this condition has been successfully treated by operation.

In the slightest cases the hernia may be readily overlooked. It is only made evident by a fusiform swelling of the cord at its point of

attachment to the abdominal wall. In some of the least marked examples the hernia has contained only a Meckel's diverticulum. The sac is within the substance of the cord.

In many cases the hernia has been included in the ligature applied by the midwife, and the bowel or the Meckel's process has been cut across. In other cases the hernia has made itself evident after the falling off of the cord by the appearance of a fecal fistula, or a bulging covered with a thick layer of lymph.

Treatment.—In the least marked varieties—assuming that no damage is inflicted upon the parts—little active treatment is called for. The bowel returns into the abdomen, and the umbilical cicatrix closes over it. In the cases of moderate degree the best measure of treatment is represented by laparotomy, reduction of the viscera, and closure of the gap by sutures. The sooner this is done after birth the better.

Dr. Macdonald * has collected thirty-one examples of this hernia. Twelve were treated by compress and bandage, and of these nine died. Nineteen were treated by laparotomy, and of this number only two died.

(2) **Infantile umbilical hernia.**—This hernia has no connection with the congenital hernia just described, nor does it follow upon it. It is due to a yielding of the umbilical cicatrix, and it appears some weeks or months after birth.

It is common, and appears with equal frequency in male and female children. It is met with in both the weakly and the robust. The rupture is small, rounded, or conical, and often button-shaped. It is covered with the thin skin of the umbilicus. It often contains omentum, and possibly a loop of small intestine. It is almost, without exception, readily reduced, and strangulation in these herniæ is exceedingly rare. As a matter of fact, this rupture appears to cause no inconvenience. Spontaneous cure is the rule, and with scarcely an exception the rupture disappears before puberty. I have seen one example of umbilical hernia in a man of twenty-five, which had persisted from infancy. Such cases are most uncommon. In not a few instances the rupture is kept from closing by the treatment, which consists in the use of a little belt carrying a rounded pad or button. This button is supposed to fit in the hernial orifice. Fortunately it is not readily kept in place, because, when adjusted as intended, this foolish appliance merely tends to keep the hernial opening from closing.

Infantile hernia is best treated by the application of a single narrow transverse slip of indiarubber strapping. This tends to draw the skin together, to approximate the margins of the hernial opening, and to prevent any protrusion when the child cries.

(3) **The umbilical hernia of adults.**—This form of hernia at the umbilicus has no connection with the two varieties just described. In only exceedingly rare instances does the infantile variety persist until adult life. The present form of hernia is

* *American Journ. of Obst.*, 1890.

practically unknown before twenty. It is most usually met with first between the ages of thirty and fifty. It is seven times more common among women than among men, and is especially apt to be found in women who are corpulent, who have pendulous abdomens, and who have had many children.

The rupture appears gradually and progresses slowly. There is at first an even, rounded, flattish swelling at the umbilicus, which becomes, in due course, larger, more prominent, and more globular. The smaller herniæ may be almost hidden in the excessively corpulent.

The rupture may attain very great size. As it grows it tends to become pendulous, and to extend towards the pubes (Fig. 825). The larger herniæ are rounded and have a wide base. They usually



Fig. 825.—Large Umbilical Hernia.

present a very irregular and lobulated surface, marked often by one or more sulci. These sulci or depressions are due to adhesions of the contents to the sac wall. The sac may be so lobulated as to appear to be double.

The coverings of the sac are usually slight, the skin being thin. Very often the outline and the movements of the contained coils can be seen through the integument. In certain instances the thin sac wall has given way and the contents of the hernia have been exposed.

The hernia usually contains omentum, and, next in frequency, some part of the transverse colon, and then certain coils of the lesser bowel. The epiploon always lies in front. The omentum is very apt to become extensively adherent; omental sacs may be

formed, and any form of omental band. Fat in great amount may develop in the protruded omentum.

Symptoms.—These herniæ are nearly always irreducible when they have attained to any size. This is due either to adhesions formed by the omentum or bowel, to the mere bulk of the protrusion and the difficulty of applying taxis, or to the development of a great quantity of fat in the expelled omentum. Patients with these herniæ are usually troubled with colic, with dyspeptic symptoms, with flatulence, and with constipation, alternating with diarrhœa. Vomiting occurs when the hernia is especially troublesome. Incarceration is more commonly met with in this form of hernia than in any other. (See page 692.) The hernia may be the seat of a peritonitis, which produces considerable local and general distress. (See page 693.) Strangulation is not uncommon, but in a large number of examples of supposed strangulation the condition is rather that of incarceration or obstruction, a condition which in these herniæ causes symptoms of much urgency, and which, if unrelieved, will end in death.

Treatment.—When the hernia is reducible, and especially when it is small, it may be fairly well treated by means of a truss. In the case of the smaller herniæ an ordinary umbilical truss is worn. This consists of a dorsal plate which is placed over the spine, of a hernial pad adjusted over the tumour, and of a spring which encircles one half of the body and which connects the plate with the pad. In some cases a spring on either side of the body is used. It is not very easy to keep this truss in place, and in the corpulent it is usually impossible. In such cases a deep and stoutly-made belt, with some elastic introduced at the sides, and fitted with understraps and a suitable plate or pad in front, may be worn. The hernial pad should be always quite flat. In large umbilical herniæ in corpulent subjects a more elaborate arrangement is called for. An appliance made by Mr. Ernst meets the needs of most cases quite satisfactorily. It consists of a light steel pelvic girdle, which takes a firm hold of the hips. From this there extends upwards along the spine a dorsal plate of suitable size and strength. Over the front of the abdomen at the site of the hernia is placed a large well-padded metal plate or shield. This is secured by side-straps to the immovable dorsal plate.

In attempting to reduce an umbilical hernia by taxis the patient should be placed in the recumbent position, with the pelvis considerably raised, and in the case of large ruptures the hands of an assistant are needed to compress the hernia on one side while the surgeon exercises pressure on the other.

When the hernia is irreducible, the palliative measures consist in the wearing of a supporting belt, in paying great attention to the diet and the bowels, and in doing what can be done to reduce redundant fat.

As an irreducible umbilical hernia is a perpetual source of danger to a patient, and very often a perpetual source of inconvenience, it

is well to entertain in all suitable cases the operation of radical cure. This consists in the removing of the whole sac, the reduction of the contents, and the closing of the gap in the abdominal wall by a double or treble row of sutures. In carefully selected cases the mortality of the operation is under 5 per cent. The younger the patient and the smaller the hernia the better are the prospects of the procedure. The operation is not suited for very large herniæ in the very corpulent. In these cases there is an immense growth of intra-abdominal fat. This very growth of fat has been one of the causes of the rupture, the viscera in the hernia having been forced out of the belly by the adipose deposit. Fat has also increased in the protruded parts, and it happens in many of these cases that the rupture is positively irreducible, even when exposed by operation. There is no room in the abdomen for the contents of the sac. If they be reduced with force they can scarcely be retained, and no sutures will stand the immense strain brought to bear upon them. So the hernia re-appears, assuming that no greater evil befalls the patient in the meantime.

If a corpulent person with a very large hernia is in good general health, and can reduce his weight by some two or three stones, then he may become a proper subject for operation, but the measure is one which will fall into discredit if its application be not reasonably curtailed.

Operations carried out when the hernia is strangulated are attended with a very high mortality, even in recent days.

Ventral hernia.—Under this term are included certain herniæ other than those found about the pelvis and at the umbilicus. Under this general heading may be considered—(1) Divarication of the recti; (2) Spontaneous ventral hernia; (3) Ventral hernia after wound; (4) Epigastric hernia; and (5) Lumbar hernia.

(1) **Divarication of the recti.**—This condition is due to an expansion and thinning of the linea alba above the umbilicus, or to a widening of the interval between the two recti muscles below the umbilicus. The linea alba, as a definite fibrous structure of independent existence, is only met with above the navel. Below the umbilicus there is merely an approximation of the sheaths of the two muscles.

A thinning and expansion of the linea alba above the navel is not uncommon in young children. When it exists there appears on the least exertion an indefinite cylindrical swelling, extending from the umbilicus to, or near to, the xiphoid cartilage. This swelling is widest below, and becomes narrower as it approaches the sternum. The condition causes no trouble, and calls for no treatment. It disappears as the body develops.

In adults a separation of the recti below the umbilicus is often observed. It is met with in females from thirty to forty-five, and especially in those who have lax and thin abdominal walls, and who have borne many children. I have seen a case in a man whose abdomen had been much distended by a pancreatic cyst. A vertical

swelling appears between the recti below the navel on the least exertion. It takes the form of a more or less extensive protrusion, with very thin coverings. The fingers can readily be introduced between the recti, and the margins of those muscles can be most distinctly felt. Sometimes the protrusion appears as a thin pendulous bag. It is nearly always placed between the pubes and the navel, but it may extend upwards beyond that cicatrix.

The condition gives rise to little trouble, and is treated by means of a suitable belt with under-straps.

(2) **Spontaneous ventral hernia.**—Genuine hernial protrusions may appear in the interval between the recti below the umbilicus. They occur mostly in women and cause but little trouble.

Hernia in one of the lineæ transversæ is a rare condition usually met with in males of advanced age. It is most common on the right side and in the transverse line which is on a level with the umbilicus.

Spontaneous hernia in the semilunar line, apart from direct inguinal hernia (page 721), is rare. It is usually met with below the level of the umbilicus, is equally common in male and female adults, and is rather more often met with on the left side.

These various ventral ruptures are treated by suitable belts.

(3) **Ventral hernia after wound.**—A hernia may follow a penetrating wound of any but small dimensions in any part of the anterior abdominal wall. These protrusions are most usually met with as a result of operation wounds that have entered the abdomen. They are more common when muscular fibres have been divided than when the wound concerns the linea alba or the gap between the recti. They are more common in the segment of the abdomen below the level of the umbilicus than in that above it. Other things being equal, they would appear to be more common in men than in women, and are certainly more frequent in the old than in the young. The circumstances which encourage them are imperfect suturing, too early removal of sutures, inefficient support to the wound, too short a period of rest after operation, failure of healing by first intention, and other more or less accidental conditions which need not be specified.

The hernia takes the form of a loose bulging, which appears on exertion or when the patient is erect. It may attain great size, especially when in the median line below the umbilicus. These herniæ cause a sense of weakness in the part, and are often attended with gastric and intestinal disturbances. Sometimes they give no trouble. I am not aware that such herniæ have ever been the seat of strangulation. The *treatment* consists either in the use of a supporting belt, or in the closure of the gap by a second operation. The latter procedure is not always attended with success.

(4) **Epigastric hernia.**—This term is applied to certain herniæ met with in the linea alba above the umbilicus. The fibres of the linea alba have for the most part a transverse direction, and the aperture in the abdominal wall through which these ruptures escape has usually its long axis placed transversely. Many varieties of hernia are met with in this situation. In some cases there is merely a

protrusion of subperitoneal fat, forming a soft lobulated tumour of small size beneath the integument, and only to be distinguished from a lipoma by the fact that it is free of the skin.

In other cases this "fatty hernia," as it is called, is accompanied by a small pouch of peritoneum, which is like a minute glove finger, and is quite free of any contents. These fatty herniæ are nearly always irreducible. They may give no kind of trouble. They may, on the other hand, be the seat of much pain and tenderness, and be associated with dyspepsia, colic, flatulence, intestinal disturbances, and even troublesome vomiting. They are much more common in men than in women, and are mostly met with between the ages of thirty and fifty. They are usually found about midway between the umbilicus and the xiphoid cartilage. They may be found nearer to the umbilicus, but they are quite rare above the midway point just named.



Fig. 826.—Lumbar Hernia in an Adult following upon Abscess.

When these herniæ give no trouble, they may be left alone; but when they cause distress, they are best removed by operation, and the opening closed.

Sometimes the larger fatty herniæ carry with them considerable pouches of peritoneum which may contain omentum, colon, or coils of the lesser bowel. Moreover, genuine herniæ, sometimes of large size, have been met with at the sites and in the subjects named. These two last-named conditions may be treated either by a belt or by an operation for a radical cure.

(5) **Lumbar hernia.**—This term is restricted to hernial protrusions, which appear in the space between the last rib and the iliac crest. Many of these are dependent upon injury or upon abscess; a few are spontaneous. Of the latter Mr. Macready has collected twenty-six examples. The spontaneous hernia has its aperture of exit most usually at Petit's triangle. In some cases it escapes through the "upper lumbar triangle" (a gap near the last rib, where the aponeurosis of the transversalis is covered only by the latissimus dorsi). In two instances the point of exit has been near the tip of the eleventh or twelfth rib.

Lumbar hernia is more common in males than in females. Three of the recorded cases have been in children, the remaining twenty-three in adults. The rupture is nearly twice as common on the left side as on the right.

The hernia appears as a globular swelling (Fig. 826), which is generally small, and which may vary in size from a walnut to a child's head. It is usually readily reducible. It may be found to be irreducible. In six of the recorded cases it became strangulated.

In three of these cases taxis was successful, while in two herniotomy was performed with one recovery.

The *truss* required for this hernia is thus described by Macready :—"The fixed point is taken from the opposite hip where a curved piece of padded metal rests between the iliac crest and the trochanter. This plate is prevented from rising by a strap passing under the thigh. The spring begins at the fore end of the hip piece, where it is fastened by a ball-and-socket joint, and, rising upwards across the abdomen, curves round the flank, and ends at the middle line behind on an oval plate, to which it is connected also by a ball-and-socket joint. The pad of the truss is fixed to the spring by a ball-and-socket joint."

Obturator hernia.—The hernia so named escapes from the pelvis into the thigh along the obturator canal. The direction of this canal is (from behind) downwards, forwards, and inwards.

Anatomy.—The viscus forming the hernia carries before it the peritoneum, the subperitoneal fat, and the pelvic fascia. Beyond the canal it may pass between the obturator membrane and the obturator externus muscle, and remain deeply placed, or it may make its way through the muscle or emerge above it, and be then covered by the pectineus and adductor brevis. The obturator nerve is generally found to the outer side of the sac, less commonly it is in front of it. The artery is, as a rule, at the outer and posterior part of the sac. It is very rarely in front of it. The sac usually contains bowel alone; omentum is seldom met with. In a few rare examples the uterine appendages have been found in the hernia. The sac is always most accessible from the inner side of the thigh, just behind the adductor longus near its origin.

Clinical features.—Obturator hernia is so much more common among women that only four cases in men were found in a total of sixty-three (Macready). It is an affection of advanced life. The average age when first noticed is about sixty.

The hernia is so exceedingly difficult to detect that any symptoms it may give rise to are apt to be ascribed to other causes. As a rule, the condition is only suspected when strangulation sets in. There may be no appreciable tumour. When a tumour does exist, it is found below the inner end of Poupart's ligament, internal to the femoral vessels, and below the pubes. It is most easily approached from the inner side of the thigh (just behind the adductor longus) when the limb is flexed, rotated out, and adducted. The tumour is more easily felt than seen, and practically never forms any visible swelling in Scarpa's triangle. The obturator canal may be examined, with the finger introduced into the vagina or rectum. Some pain may be elicited by making tense the obturator externus muscle by vigorous rotation inwards of the slightly abducted thigh.

When the hernia is strangulated, there may be tenderness over the site of the rupture and pain on moving the thigh.

Pain along the course of the obturator nerve has been a symptom in 42 per cent. of the recorded cases (Macready).

When strangulation occurs in this rupture the death-rate is very high, nearly 90 per cent.

Treatment.—No kind of truss can be worn for this protrusion. Should a non-strangulated hernia be discovered, it would be well—in view of the great danger incident to these ruptures—to carry out an operation for the closure of the sac in all suitable cases.

When strangulated, this hernia has been treated by herniotomy with success. A vertical incision is made in the upper part of Scarpa's triangle, internal to the femoral vein. The pectineus is exposed, and the interval is sought between the pectineus and the adductor longus. When those muscles are well separated, the tumour will come into view.

Ischiatic hernia.—In this rare hernia the viscus escapes at the great sacro-sciatic notch. The sac may protrude above or below the pyriformis muscle, and is generally covered by the pelvic fascia. The hernia on reaching the thigh crosses the great sciatic nerve on its posterior aspect, and lies beneath the gluteus maximus muscle. If it attain large size, it may emerge from beneath the lower border of that muscle.

The hernia is very readily overlooked, and could easily be mistaken for a deep-seated lipoma, a cyst, or an abscess. In some instances these herniæ have been attended by much pain about the buttock, genitals, and thigh. There may be pain on walking.

The hernia is usually met with in adults, and is equally distributed between the two sexes. A few cases have been recorded in children. The sac may contain omentum or bowel, or the ovary or a part of the urinary bladder.

The hernia is usually reducible. It may be irreducible or may become strangulated. In the latter condition it has been operated upon with success.

An efficient *truss* can scarcely be applied in these cases, and if owing to strangulation, an operation is called for, it will usually be well to approach the hernia through a median abdominal incision.

Perinæal and pudendal herniæ.—Herniæ occasionally escape through gaps made in the soft parts which fill in the outlet of the pelvis. They may appear in the perinæum (perinæal hernia) or in the ischio-rectal fossa (ischio-rectal hernia). The sac may protrude through the wall of the vagina (vaginal hernia) or may make its way into the posterior part of the labium majus (pudendal hernia).

In all these instances the sac will probably push a portion of the recto-vesical fascia before it, and will penetrate the levator ani muscle, or be partly covered by its fibres.

The contents of these herniæ are usually coils of the small intestine, but cases are recorded in which the sigmoid flexure, the bladder, or the ovary has been found in these protrusions.

Macready has collected forty examples of hernia through the pelvic outlet. Of these, six were in males and thirty-four in females. All the patients were adults. In the male the perinæal

and ischio-rectal forms are met with ; in the female the ischio-rectal, vaginal and pudendal forms. Of these the pudendal is the most common.

Characters.—*The perineal hernia* presents as a soft swelling on one or other side of the median line. It is only met with in males.

The ischio-rectal hernia is more common in women than in men. It takes the form of a soft globular swelling, occupying the ischio-rectal fossa, and may attain considerable dimensions.

The vaginal hernia enters the vagina on one side, and usually high up in the canal. It appears as a pendulous swelling covered by mucous membrane, and projecting into the vaginal passage. It has been mistaken for polyp.

The pudendal hernia has a sac which extends into the posterior part of the labium maius. It is the commonest of these herniæ in women, and is more often met with on the right side than on the left. It bulges out the hinder part of the labium, and often causes a part of the vagina to protrude. It has been mistaken for a cyst.

These herniæ of the pelvic outlet seldom cause much trouble. They are usually reducible. They may become irreducible, especially when the bladder occupies the sac, and in a few rare instances strangulation has occurred.

Treatment.—When reducible, these ruptures may be supported by special trusses adapted to the requirements of the various cases, or by pessaries in certain of the herniæ in women. When irreducible, an operation for the removal of the sac would usually be advisable in properly selected cases.

XLIX. DISEASES OF THE RECTUM.

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Wounds of the rectum and anus.—The position occupied by the rectum renders a wound of this organ a somewhat unusual accident, as compared with the more exposed parts of the body. Nevertheless, there are various ways in which such injuries may occur. They may be conveniently classified as follows:—

(1) Puncture of rectum by pieces of bone, pins, or other hard substances swallowed.

(2) Perforation of the walls of the bowel by foreign bodies, enema pipes, or other substances introduced through the anus.

(3) Gunshot and other penetrating wounds passing secondarily through the rectum.

(4) Wounds caused secondarily to fracture of the pelvis.

(5) Laceration of anus and rectum during parturition.

(6) Wounds made by the surgeon intentionally in many operations, or accidentally, as in the operation of lateral lithotomy.

(1) **Injuries by substances swallowed.**—Owing to the sudden way in which the rectal pouch narrows at the anus, substances which have thus far safely made the tour of the alimentary tract may become arrested, and possibly puncture the coats of the bowel and give rise to abscess and fistula. I removed the prong of a horn hair-comb which was transfixing the lower end of the rectum of a young man; fish bones, pins, and such substances are not infrequently found in a like condition. They give rise to a considerable amount of discomfort and pain during defecation, are easily recognised by digital examination, and readily removed. (*See* page 740.)

(2) **Injuries by foreign bodies introduced through the anus.**—A number of cases have been recorded in which an enema tube has been forced through the healthy rectum, and the injection discharged either into the peritoneal cavity, or into the loose areolar tissue surrounding the bowel. So slight is the sensibility of the rectum a little way from the anus that this accident has happened while the patient was giving himself an injection. Where the perforation occurs into the peritoneal cavity, death has in a number of cases resulted; and where the areolar spaces of the pelvis

are penetrated, diffuse suppuration, which is likely to prove fatal, is a probable result. Similarly, foreign bodies are sometimes forcibly thrust through the anus, and perforate the rectal wall above. There was some time ago, under the care of my colleague, Professor Bennett, in Sir Patrick Dun's Hospital, Dublin, a man with a recto-urethral fistula, which resulted from his being impaled by a pitchfork. While sliding down a hayrick one prong passed through the anus, injuring the prostatic urethra, while the other passed up between his legs without doing any injury.

Many similar cases are recorded of persons falling on bodies which penetrated the rectum, as the leg of a chair, stakes in the ground, the handle of tongs, etc. These cases are interesting as showing how serious injuries might be inflicted upon the abdominal viscera without any cutaneous wound existing; and in the absence of any accurate history, considerable difficulty might be found in making a diagnosis. A case is recorded by Birkett,* in which a patient, suffering from rectal ulcer, himself passed an enema syringe through the floor of the ulcer, opening up the loose areolar tissue of the pelvis. This was followed by emphysema of the entire lower part of the abdomen; and as this symptom has occurred in other cases, such as the apparently trivial operation of tapping the bladder through the rectum, it might prove useful in establishing a diagnosis in obscure cases.

(3) **Gunshot wounds.**—Dr. J. Marion Sims has pointed out † that bullet wounds of the pelvis, even when passing through the rectum, bladder, and peritoneum, are by no means absolutely fatal injuries; and he makes a very forcible contrast between these and perforating wounds of the abdominal cavity. Of the seven cases of the former occurring within his knowledge at Sedan, all recovered, while seven of the latter all proved fatal. Of gunshot wounds of the rectum during the American War, Otis ‡ collected 103 cases with a fatality of 42·7 per cent.; in 34 of these the bladder also was wounded, with a mortality of 41·17 per cent. Dr. Sims attributes the more favourable result in pelvic injuries to the fact of free drainage. When the abdominal cavity is perforated, fluids collect in the pelvis, become septic, and lead to a fatal result; but where a man is shot through the pelvis, efficient drainage is more likely to result.

(4) **Wounds due to fracture of the pelvis.**—Wounds associated with fracture of the pelvis are usually very grave injuries, on account of the great amount of injury inflicted on important structures. As in the previous case, emphysema may be a symptom, and also bleeding from the anus may indicate the complication.

(5) **Lacerations during parturition.**—During parturition injury to the rectum frequently occurs, the recto-vaginal septum being torn through more or less, in addition to rupture of the

* Holmes's "System of Surgery," vol. ii. p. 753. Second edition.

† *British Medical Journal*, February 18, 1882.

‡ Ashhurst, "Encyclopædia of Surgery," vol. ii. p. 199.

perinæum; or even the septum may give way without tear of the perinæum, the child being born through the anus. The fuller details of such cases and the treatment to be adopted will be found in obstetric works.

(6) **Operation and other wounds.**—Of the incised wounds resulting directly from operation it is not necessary to speak.

Accidental wound of the rectum during the performance of lithotomy does not generally prove troublesome, owing to the free drainage from the wound. In a few cases, however, recto-urethral fistulæ have been established.

Prognosis.—A consideration of the histories of rectal injuries shows that where the wound is extensive, and consequently drainage free, the prognosis is tolerably good; whereas, punctured wounds, in which the conditions of free drainage are not found, are apt to be followed by putrid emphysema, extravasation of fæces, diffuse inflammation, and other more serious septic complications.

Treatment.—I feel convinced that the proper treatment to adopt in cases of punctured wound of the rectum through the anus, especially if low down, would be to divide the sphincter and rectal wall freely up to the point of puncture. With a free vent thus permitted, neither fæces nor flatus can be forced into the areolar tissue or peritonæum, and thorough drainage is established. In other respects, wounds of the rectum present no peculiar features for treatment, which, of course, should be conducted on intelligent antiseptic principles.

Foreign bodies in the rectum.—Various substances may reach the lower bowel either by descending from other parts of the alimentary tract, or by being introduced through the anus, while occasionally concretions form in the bowel itself, generally, however, round a foreign body as a nucleus which has reached the rectum by one of the above ways.

The size of those bodies which make the tour of the alimentary tract before reaching the rectum is, of course, limited by the dimensions of the ileo-cecal valve; but such substances as plates for artificial teeth, nails, pieces of glass and earthenware, stones, pins, needles, etc., have thus found entrance to the lower bowel, where they may lodge in the pouch just above the sphincter.

Foreign bodies introduced into the rectum through the anus may be the result of accident. More frequently, however, they have been introduced from some perverted sexual impulse, and have slipped out of reach.

It is astonishing the variety and sometimes large size of articles that have been found in the lower bowel. It would, of course, be useless to recount them all, but the following are a few of those collected by Poulet: * pieces of wood, snails, glass bottles, crockery, stones, tin-covers, preserve jars, pieces of soap, fork, handle of shovel, pepper-box, pig's tail, upholsterer's nails, ale glass, bottle of

* "Foreign Bodies in Surgery," vol. i. p. 222.

mushrooms, etc. The length of some of the foreign bodies found here is considerable. Velpeau * removed an eau-de-cologne bottle over eleven inches long; while Laure † records a case in which a wooden club was withdrawn from the rectum of a man aged sixty years, which measured twelve and a half inches; the upper end caused a projection in the right hypochondrium; the patient recovered. It is hard to imagine how such an article could be introduced so far without producing fatal mischief.

Treatment.—The removal of foreign bodies from the rectum may tax considerably the ingenuity of the surgeon. If the body be large and friable, great care must be exercised. In the first place it is well to dilate the anus very thoroughly, when possibly the substance may be expelled naturally; if not, its removal must be attempted by the aid of forceps, etc.

If the foreign body be a bottle, and the neck presents, a strong forceps may be passed through the neck, widely divaricated, and used as a means of traction. If, however, as is more likely to be the case, the bottom of the bottle presents, greater difficulty will be experienced. Possibly a loop of wire may be slipped up until the neck of the bottle is reached, and thus traction made.

Where foreign bodies have passed up so far that they cannot be satisfactorily reached through the anus, the records of surgery show that a successful result has on several occasions been obtained by laparotomy, opening of the colon, and removal of the object.

Congenital malformations of the rectum and anus.

Development.—In order to arrive at an understanding of the method of production of the various forms of congenital malformation, it will be necessary for us briefly to refer to the development of the intestinal tract; it will, however, be possible here only to refer to the more important facts.

The mesenteron or central portion of the alimentary tract is formed from the hypoblast, and consists, in the first instance, of a simple tube which ends at the anterior extremity of the embryo in a blind sac, while at the posterior extremity a similar cul-de-sac is formed, communicating with the neural canal by a minute opening (the neurenteric canal). This tube of hypoblast represents only what is to constitute the mucous membrane of the alimentary tract, the other coats of the intestine being subsequently formed by this hypoblastic portion becoming enveloped in a layer of mesoblast, which differentiates into two portions, the outer forming the peritoneal covering, while the inner develops into the muscular and connective tissue elements of the intestinal wall.

An invagination of epiblast at the posterior extremity, called the *proctodæum*, forms the anal and genito-urinary orifice, and communicates with the mesenteron at the end of the fifth week. It will be necessary to study this proctodæum a little more in detail. If a human embryo about the sixth week be examined, it will

Arch. Gén. de Méd., 4th série, tome xxi.

† *Gazette Médicale de Lyon*, 1868.

be found that immediately in front of the coccygeal eminence, which at that period of development is relatively very prominent, a slight elevation with a median furrow is to be seen; from this eventually



Fig. 827. Congenital Malformation—absence of proctodæum, rectum terminating in a cul-de-sac at lower outlet of pelvis.



Fig. 828.—Congenital Malformation—absence of proctodæum, lower portion of rectum terminating in a cul-de-sac above the bladder.

will be developed the permanent anus and generative organs, but as yet they are not differentiated. At about the eighth or ninth week the anus will be separated from this cloacal opening, and the rudiments of the perineal septum will have been formed; and in an embryo of about ten weeks, when the genital organs will have been so far developed that it is possible to determine sex, the anus also will have been fully formed and separated by a distinct septum from the structures of the anterior perineum.



Fig. 829. Congenital Malformation—membranous occlusion of rectum; failure of communication between proctodæum and mesenteron.



Fig. 830.—Congenital Malformation.—proctodæum opening into vagina instead of mesenteron.

Varieties of malformation.—The explanation of the very various forms of congenital malformation is to be found in errors in this developmental process, and may be conveniently classified into (1) errors of development of the proctodæum, (2) failure in the continuity of the perineal septum, (3) persistence of the post-anal gut or neurenteric canal.

(1) The proctodæum may be absent, the rectum terminating low down, as in Fig. 827, or being itself undeveloped in its lower portion, terminating in a cul-de-sac in the abdomen or pelvis at a variable distance from the normal position (Fig. 828).



Fig. 831.—Congenital Malformation—rectum ending in bladder (atresia ani vesicalis).



Fig. 832.—Congenital Malformation—rectum ending in urethra (atresia ani urethralis).

In other cases the proctodæum is normally formed, but fails to effect a communication with the rectum. When this is the case, the separation between the two tubes is usually merely membranous (Fig. 829), while more rarely they are further separated from one another, and connected by a muscular cord.

In other cases, instead of the two constituent portions of the rectum abutting one against the other, they may for a short distance pass parallel to one another, the anal portion usually passing in



Fig. 833.—Congenital Malformation—the rectum ending in a narrow channel opening beneath the prepuce. (Cruveilhier.)



Fig. 834.—Congenital Malformation—rectum ending in the vagina (atresia ani vaginalis).

front; indeed, the latter has been known to open into the vagina, while the upper portion terminated in a cul-de-sac (Fig. 830).

(2) Failure in the continuity of perineal septum, the rectum opening at some portion of the genito-urinary system.

In the majority of these cases the proctodæum is absent, and the rectum may be found opening into (a) the bladder, (b) the

urethra, (c) under the prepuce, and (d) the vagina (Figs. 831, 832, 833, 834).

The converse of these cases has also been noticed, but is extremely rare—*i.e.* where the bladder, ureters, or vagina open into an otherwise normally-formed rectum.

(3) Persistence of post-anal gut or neurenteric canal.

These cases are of extreme rarity, and have not as yet been



Fig. 835.—Case of Imperforate Anus—the intestine opens at the left side of a spina bifida; persistence of neurenteric canal.

thoroughly studied; but, apparently, the cases where the rectum opens through an aperture in the sacrum, or where, as happened in a case related to me by Mr. Wheeler, an anus discharging meconium was found in connection with a spina bifida in the lumbar region (Fig. 835), can only be satisfactorily explained by a persistence of the neurenteric canal, while the isolated cases of true diverticulum of the rectum apparently indicate that occasionally the post-anal gut is not obliterated.

Symptoms. The symptoms of congenital malformation obviously vary with the varieties above mentioned. Where no exit is

provided for meconium, symptoms of obstruction soon develop, while in some cases of vulvar and vaginal anus but little inconvenience is experienced. Where the rectum opens into the bladder or urethra the relief is insufficient, and grave symptoms sooner or later develop.

Treatment.—When an infant does not defæcate, when the abdomen becomes distended and vomiting sets in, an examination will frequently demonstrate one of the above abnormalities, and if obstruction is complete, immediate operation is essential to save life. Where the rectum is either seen or felt to bulge into the perinæum, all that is necessary is to incise the bowel in the normal situation of the anus, and carefully stitch the mucous membrane to the skin wound, thus forming a permanent opening. Where, however, no trace of a distended bowel can be felt in the perinæum, extreme difficulty may be experienced. If the pelvis be well formed, an attempt may be made to reach the bowel by careful incision through the perinæum, continuing the incision backwards to the hollow of the sacrum, or even excising the coccyx, in order to obtain room. If, however, this incision fails, laparo-colotomy is the only resource. This operation should, in the first instance, be resorted to if the pelvis is deformed, with the lower outlet much narrowed, as in such cases the rectum does not probably come low enough down into the pelvis to be reached by perinæal incision. Laparo-colotomy is also indicated when the rectum opens into the bladder or urethra. A vaginal anus, if it is sufficiently free, may be left until the child grows strong, when the vaginal anus may be transplanted into its normal position, and the vaginal wound sutured up.

Proctitis. Inflammation of the rectum.—Proctitis is not a common affection in the British Isles. It may, however, result from injury, or appear as a specific inflammation—*i.e.* catarrhal, dysenteric, and gonorrhœal.

Of catarrhal proctitis the acute and chronic forms may be recognised.

Acute catarrhal proctitis presents many symptoms in common with dysentery, and the difference is rather one of degree than kind. I shall, therefore, confine the term to those cases in which the inflammatory process is limited to the rectum, and in which the abdominal pain and constitutional symptoms of typical dysentery are absent. As such we not infrequently meet with cases, especially in children.

The *symptoms* are great tenesmus; with the frequent passage of small quantities of bloody mucus, at first mixed with feces, and then alone; at the same time there is vesical irritation, and general sense of heat and weight about the pelvis, resulting from the inflammation of the mucous and submucous tissue; oedema of the mucous membrane is not uncommon, and frequently, in consequence, a partial prolapse takes place.

Chronic catarrhal proctitis.—Where acute catarrhal proctitis has merged into the chronic form, the *symptoms* become somewhat modified; the acute pain and tenesmus give place rather to a

sense of weight and fulness than actual pain. The discharge also becomes altered; instead of consisting of a tolerably intimate mixture of blood and mucus, as is found in the acute form, it becomes more purulent, and if blood is present it exists as streaks in the pus, which have evidently arisen from ulcerations of the mucous membrane rather than from a general oozing from the inflamed surface. On inspection the mucous membrane appears more thickened and indurated, but the œdema is less. Ulceration of the surface is also more frequent in the chronic form.

Dysenteric proctitis.—Of the specific inflammations, dysentery is much the most important, and although not always confined to the rectum, this portion of the intestinal tube is more or less affected in all cases, and sometimes the typical lesions are only to be found here. But few opportunities offer themselves to civil surgeons in Great Britain of investigating this disease during its acute stages; but amongst Anglo-Indians and others who have resided for a long time in tropical climates, the chronic form and some of the important sequelæ are not infrequently met with.

For a full account of dysentery I must refer the reader to the systematic treatises on medicine, as a detailed investigation of this subject would be quite beyond the intention of the present Article.

Gonorrhœal proctitis.—As a result of gonorrhœa the rectum occasionally becomes the seat of acute purulent inflammation. In women this may occur in consequence of the discharge escaping from the vagina and trickling over the anus, the liability to secondary infection being greatly increased by the presence of prolapse of the mucous membrane, piles, fissure, or relaxation of the sphincter from any cause. In men, and in women in whom the anus is normal, the disease probably only originates as a result of the direct introduction of virus within the sphincter.

Gonorrhœal inflammation of the rectum is decidedly uncommon. It is characterised by a severe purulent discharge, with much pain and throbbing. On microscopic examination the pus may reveal the presence of gonococci.

Treatment of proctitis.—In dealing with *acute proctitis* the first essential is to evacuate the canal, and this should be accomplished by the administration of purgatives, not by enemas, owing to the pain that the latter occasion and the danger of spreading infection up the intestine. Some saline will usually prove most suitable, preferably sulphate of soda, or sulphate of magnesia in some form, such as the more potent mineral waters; or the effervescent sulphate of soda will be found an easily taken and satisfactory aperient. Such powerful drugs as gamboge, jalap, etc., must be carefully avoided. Where it can be taken without much nausea, castor oil will fulfil every requirement. Absolute rest in bed is essential, and the occasional use of a hot hip-bath will give relief. The diet should be carefully regulated. All food leaving a copious fecal residue is to be avoided; and during the acute stage the patient should be restricted to milk, strong meat-soups, and eggs. If there is much tenesmus, injection of

two ounces of mucilage of starch with a few drops of tincture of opium may be used, but as a rule it is better not to use opium or morphia to any great extent, as, owing to its tendency to produce constipation, the disease may be aggravated. A suppository, consisting of 5 grains of iodoform, with $\frac{1}{2}$ -grain extract of belladonna, made up with oil of theobroma, will be found useful. In dysentery, in addition to the foregoing, the use of ipecacuanha in large doses is indicated; and, where there is much exhaustion, the free use of stimulants.

Where inflammation of the rectum has become *chronic*, astringents must be employed. Nitrate of silver, 5 grains to 2 ounces of water, may be introduced into the bowel, followed in a few minutes by a large enema of warm water to wash out the rectum; or liquor bismuthi with glycerine of starch, in the proportion of 2 drachms of the former to 2 ounces of the latter, will sometimes check the discharge of pus; and where the discharge is fœtid, the following formula may be tried:

R. Liquor. carbonis detergens	3 ij
Tr. krameria	3 iv
Mucilag. amyli	ad 3 iv

An ounce to be injected night and morning.

For the *sequelæ of proctitis* the reader is referred to the sections on Periproctitis, Ulcer, and Stricture.

Periproctitis.—Periproctitis, or inflammation in the tissues surrounding the lower bowel, may appear as a diffuse or localised septic process.

Diffuse periproctitis is a very serious disease, and a not infrequent cause of death after the more severe rectal operations and other traumatism. It in all respects resembles the septic poisoning following parturition, known as parametritis and puerperal fever, producing widespread inflammation of the lymph paths of the pelvis, and frequently peritonitis.

The onset of a case of diffuse periproctitis is marked by high fever, possibly rigors and sweating coming on after an incubation period of a few days; vomiting, meteorism, painful micturition, and great abdominal pain will indicate the involvement of the peritoneum.

As far as *treatment* is concerned, we can do but little in the more severe forms of infection. Where matter forms in the neighbourhood of the rectum, free incision, followed by irrigation with some antiseptic solution, and free drainage, should at once be adopted. Where the peritoneum has become implicated, opium in full doses is indicated, with the double object of relieving pain and lessening peristaltic action.

The prophylactic treatment, however, holds out to us better hopes of success. Improved methods of wound treatment have largely diminished the number of cases in which septic periproctitis follows even such severe operations as excision of the rectum; but unfortunately cases are still to be met with, the difficulties of obtaining a

complete asepsis being obviously so much greater here than in other parts of the body.

Gangrenous periproctitis is a rare form of inflammation, in which there is a great amount of necrosis of tissue. The cases resemble, in extent of sloughing, what is seen in extravasation of urine, except that in the latter it is about the anterior perinæum and scrotum, etc., that the sloughing chiefly takes place. Prompt treatment by incision is indicated, with the most liberal support of the patient's strength.

Localised periproctitis. Rectal abscess.—Inflammation, ending in abscess, may occur in the skin of the anal canal, in the ischio-rectal fossa, in the wall of the rectum itself, or in the superior pelvi-rectal space. Of these, however, the *ischio-rectal abscess* is vastly the most important.

A large proportion of ischio-rectal abscesses owe their origin to a perforation of the rectum, the result of traumatism or ulceration; while in other cases they arise from septic infection from one of the little cracks about the anus, in the same way that we see mammary abscess follow chapped nipples.

Symptoms.—The formation of acute ischio-rectal abscess is attended, in the majority of cases, with some fever, and the constitutional disturbance is generally out of all proportion to the local disease. The pain is severe, and is increased by defæcation; there is frequently irritability of the bladder; strangury, or retention of urine being a not uncommon symptom. Its situation is most frequently on the lateral aspect of the anus, and it presents itself as a prominent, tense, red, and shining swelling, in which fluctuation is distinctly to be felt.

Treatment.—The moment that fluctuation is detected the pus should be evacuated by incision. It is best to give an anæsthetic, and thoroughly wash out and curette the cavity, fill it subsequently with boric acid, and apply an antiseptic pad. In this way, if taken early, it is usually possible to prevent the occurrence of a fistula. Chronic ischio-rectal abscess is generally the result of tubercle, and is to be treated as cold abscess in other parts of the body.

Rectal fistula. Varieties.—By this term is meant a suppurating tract left after an abscess. It is called *complete* when there is an orifice on the cutaneous, and also on the mucous surfaces, and *incomplete* when only one orifice exists. The latter is more fitly designated sinus—internal rectal sinus (*blind internal fistula*) when the single opening is mucous, and external rectal sinus (*blind external fistula*) when the opening is cutaneous.

Complete rectal fistula.—The ordinary form of complete rectal fistula is the result of abscess in the ischio-rectal fossa, either primary, or secondary to changes in the rectal wall, and the position occupied by the *internal opening* is tolerably constant, being situated between the two sphincters. The *external opening* is subject to more variety, but is generally within one inch from the anal verge,

though occasionally at a considerably greater distance, as in the groin or thigh. The position of the internal opening in this variety is a subject of very considerable importance, as, unless acquainted with its usual situation, the surgeon may fail to find it; the reason for this being, that in most cases the mucous membrane of the bowel has been separated from the muscular wall for a variable height above the orifice, so that the opening is not really at the highest point to which suppuration has extended, as one might be led to expect, but close to the muco-cutaneous junction. Multiple external openings are common, but the internal opening is usually single. When the internal and external openings are on opposite sides, the case is spoken of as a "*horse-shoe fistula*."

Abscess of the superior pelvi-rectal space may give rise to a fistula altogether above the pelvic diaphragm; while the marginal abscess may form a little fistula, that is surgically unimportant.

Symptoms of fistula.—The symptoms of which fistulous patients complain vary according as to whether there is active suppuration going on or not. The abscess from which the fistula originates is, if acute, extremely painful: though sometimes, as before noticed, a cold or chronic abscess may occur in this locality, in which case the initial pain is slight, and the first symptoms noticed by the patient are discharge or involuntary escape of flatus, and, more rarely, a small quantity of feces. With a fistula fully established, little pain is experienced, but considerable annoyance is occasioned by the soiling of the linen with discharge, which is generally accompanied by an unpleasant odour. There is generally some tenesmus, and the feces may be stained with blood, etc., except when the case is one of external rectal sinus.

A person suffering from fistula is always liable to attacks of secondary suppuration, due to blocking of the tract by small particles of feces or exuberant growth of the granulations. This, of course, is attended with pain, until a new opening forms or is made by the surgeon, or until, as sometimes happens, the passage of the original fistulous tract becomes re-established.

Examination of fistula.—In order to examine a patient suffering from fistula, a probe should be gently passed through the external opening, and subsequently a finger introduced into the rectum. If the end of the probe is felt free in the rectum the diagnosis is complete; if the probe passes up beside the rectum for a long distance, a considerable thickness of tissue intervening between the probe and the finger, the fistula has probably originated in the superior pelvi-rectal space; if the probe passes through the muscular coat of the bowel, the mucous membrane alone intervening between the probe and finger, an internal opening in all probability exists. If it is impossible to find this with the probe, milk or other coloured fluid should be injected into the fistula, and if it is complete the fluid may be seen, by means of a speculum, escaping into the rectum.

Treatment of fistula.—Nothing short of the division of the intervening tissue between the fistula and the rectum should be

countenanced, as by this means alone can a cure be effected. This may be done by passing a probe-pointed bistoury through the fistula, and with a finger in the rectum the intervening tissues can be safely divided, or a probe-pointed director can be passed through the fistula, and hooked out at the anus, and the overlying structures divided on it; if more than one external opening exists, the sinuses



Fig. 836.—Allingham's Screw Ointment Introducer.

leading thereto should be slit up; the sharp spoon should now be freely used, and all trace of granulation tissue removed from the entire ramifications of the fistula; after thorough disinfection of the surface, deep sutures may be passed, so as entirely to close the wound, and an antiseptic pad applied. In this way it is possible to cure a case of fistula in a week or ten days, whereas the old way of plugging the wound, and letting it heal from the bottom, took a very long time, and was frequently followed by incontinence of feces; even in cases of tuberculous fistulæ where phthisis co-exists, if the sharp spoon is liberally used a cure may be obtained. In the treatment of external and internal rectal sinus also, free clearing out of the granulation tissue, followed by antiseptic dressing, is indicated.

Where a cutting operation is persistently refused by the patient, an indiarubber ligature, passed through the fistula, out at the anus, and tied tightly, will effect a cure; but the course is slow and result uncertain, as compared with the more definite method above-mentioned. The pain of the ligature is also much more severe.

Ulceration of the rectum. Congestive ulcer.—A dilated and varicose condition of the veins of the rectum is of common occurrence, hence it can readily be understood that a congestive ulcer, similar to a varicose ulcer of the leg, may readily follow any slight injury, or originate spontaneously; still it must be admitted that a hæmorrhoidal ulcer is uncommon. It is characterised by marked chronicity, elevated irregular edges, and a tendency to bleed. Its situation is usually well within the external sphincter, and confined to the mucous membrane; it does not implicate the anal verge. The amount of pain that the patient suffers is slight, in this respect contrasting markedly with the irritable ulcer or fissure.

The treatment of this form of ulceration is not very satisfactory. Rest in the recumbent position is necessary, for the same reason that we prescribe it in varicose ulcer of the leg. The bowels should be kept regular, preferably by some of the saline mineral waters given in sufficient quantity to ensure one soft motion daily. At the same time the diet should be so regulated that the feces may be as unirritating as possible; indeed, an exclusive milk diet may sometimes be advantageous. For local treatment an injection of liq. bismuthi, ʒss; liq. morphinæ, min. xv; mucilag. amyli ad ʒij, night

and morning, will be found of service; or, where a more powerful astringent appears indicated, a solution of nitrate of silver in water, 2 or 3 grains to the ounce, may be tried. In other cases the introduction of boric acid ointment, by means of Allingham's instrument (Fig. 836), will answer better.

Follicular ulcer.—A form of ulceration originating in the solitary follicles is occasionally met with (Fig. 837); it appears to be connected with the superficial ulcerations found in chronic dysentery. When occurring low down it may be diagnosed by the speculum or digital examination; the indications for treatment are the same as in the hæmorrhoidal variety.

Tuberculous ulcer.—Intestinal tuberculosis and ulceration may be either a primary disease, or it may be secondary to similar changes in the lungs. In the first instance the cause is, in all probability, a direct inoculation by the ingestion of bacilli in the food; and in the second the sputum which the patient swallows, as pointed out by Klebs, is the probable source of infection. When implicating the rectum, tuberculous ulceration may, in the generality of cases, be recognised by the following characters:—

Symptoms.—The edges of the sore are much undermined and ragged, and there is considerable infiltration of the mucous membrane in the immediate neighbourhood. It is impossible to draw any definite line between the limited tuberculous ulcers met with in this region and the more extensive destruction of tissue which has been described as lupoid ulcer (Fig. 838). Tuberculous ulcers of the intestine manifest a strong tendency to perforate the bowel; hence it is that fistula is such a common result as a sequela to this disease when situated in the lower portions of the rectum.

Treatment.—When tuberculous ulceration is diagnosed before a fistula has formed, a thorough scraping with a sharp curette, followed by a liberal use of nitrate of silver, will frequently effect a cure; and even where a tuberculous fistula has formed, if all sinuses are slit up and thoroughly curetted, a good result may be obtained. In cases of so-called lupoid or rodent ulcer of the rectum, excision is the proper treatment.

Syphilis and dysentery are both the cause of extensive ulceration of the bowel, and indications of these systemic diseases should be sought for in every case of extensive rectal ulceration.



Fig. 837.—Follicular Ulceration of Rectum. (Museum, Royal College of Surgeons, Ireland.)

Irritable ulcer or fissure of the anus.—In the whole range of surgery there are but few diseases which, while of very limited extent, produce such extreme misery to the patient, and none in which surgical treatment is attended with more certain success than in the affection under consideration. The subjective phenomena of

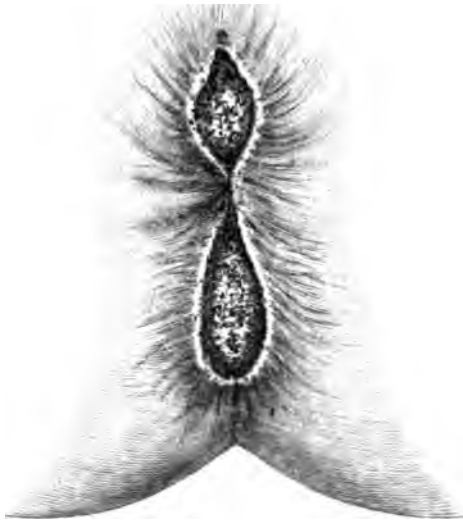


Fig. 838.—Lupoid Ulceration of the Rectum and Anus.

irritable anal ulcer present a train of symptoms which are eminently characteristic, and alone are frequently sufficient for diagnosis.

Symptoms.—The pain is paroxysmal and always associated with the act of defecation. During the actual passage of the motion, however, it is not usually severe, but shortly afterwards it comes on with great intensity; it is a dull, gnawing, and extremely distressing sensation, situated immediately within the anus, and not infrequently associated with some of the reflected pains before alluded to. It lasts often for many hours, completely incapacitating the sufferer from following his occupation, and necessitating the recumbent position while it lasts. In then subsides or entirely disappears, to be, however, reproduced in all its intensity when next the bowels move. The act of defecation is therefore postponed as long as possible, with the result that when the evacuation does take place the pain is greatly increased.

Upon making an examination, the first thing that attracts our notice is a small "sentinel" pile. On passing the finger round the anus one part of the circumference is found to be tender, and any

attempt to introduce the finger gives a great deal of pain, and is violently resisted. Upon separating the anal folds the lower termination of the fissure can generally be seen, the surface being red or grey, and the edges somewhat indurated. The ulcer is usually somewhat triangular, the base being formed by the sentinel pile.

Cause.—Until quite recently it was taught that the following sequence of events occurs as tending to produce the fully formed irritable ulcer. During the passage of a costive and large motion a rent in the mucous membrane is made; or an excoriation, the result of syphilis, dirt, etc., exposes one of the delicate nervous twigs. As a result of the constant motion and distension, and by the lodgment of particles of fæces in the rent, continued irritation

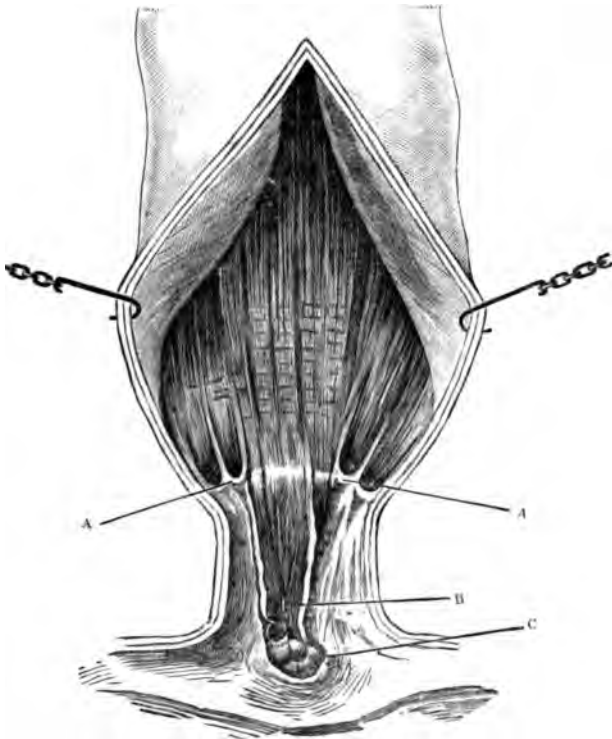


Fig. 839.—The illustration (taken from a drawing kindly made for me by my resident pupil, Mr. Kennan, from a specimen accidentally found in the *post-mortem* room) well indicates the points to which I desire to call attention. The rectum and anus were removed from the body and opened by a vertical anterior incision. Where the contracted anal canal joins the rectum the white line described by Hilton is to be seen, and at this level four of the anal valves (A), with the pouches behind them, are distinctly observable. In this specimen they are much more pronounced than usual, so that it can be readily understood how liable they are to be caught and torn during defecation. At C is to be seen the "sentinel pile," and at B the fissure which had cicatrised. This so-called pile is here obviously one of the posterior anal valves which was torn down and has become thickened and oedematous.

is set up, which, in turn, occasions spasm of the sphincter. The spasm once started, the irritation is increased, and so a vicious circle is established, and the result is that the ulcer is never allowed to heal.

I am quite satisfied that the true explanation of the formation of the vast majority, if not of all, painful fissures is as follows :—During the passage of a motion one of the little anal valves is caught by some projection in the fecal mass and its lateral attachments are torn ; at each subsequent motion the little sore thus made is reopened and possibly extended, the repeated interference with the attempts at healing ends in the production of an ulcer, and the torn-down valve becomes swollen and oedematous, constituting the so-called pile, or “sentinel pile” of the fissure (Fig. 839). Most of us have experienced the little bits of skin torn down at the sides of the finger-nails, popularly called “torments,” and how painful they are when dragged upon. Now the torn-down anal valve resembles closely this condition of the finger, except that it is situated at the acutely sensitive anal margin, and subjected to the periodic strain of a passing motion ; it is therefore not to be wondered at that the pain should be so excessive as seriously to affect the general health and render life miserable.

Treatment.—Boyer first showed that a complete division of the sphincter muscle was followed by cure ; it was subsequently shown that a limited incision of this muscle, or even its temporary paralysis from over-distension, was followed by a like result, these methods of treatment have been universal, but although undoubtedly simple and generally successful, are still of unnecessary severity.

What I recommend in these cases where the classic symptoms of painful fissure are present is as follows :—Do not subject the patient to the pain of extended digital examination, much less occasion him the torture of passing a speculum ; but, after having the bowels fully relieved by an efficient aperient, administer an anæsthetic, and dilate the anus with the fingers sufficiently to obtain a good view of the entire circumference of the muco-cutaneous junction ; then, if the symptoms have been characteristic, a little ulcer will almost certainly be found, and at its lower extremity the torn-down anal valve sometimes greatly hypertrophied. All that is now necessary is to catch this in a forceps, and with a fine pair of scissors remove it by a V-shaped incision, with base towards the ulcer, so that nothing is left that can be caught by a passing fecal mass. If there is any unhealthy granulation tissue in the ulcer, this should be removed with the sharp spoon, and the surface well dusted with boric acid ; the cure will then be as immediate and certain as when the “torment” at the side of the finger-nail is shaved off level with the skin. It is advisable after this little operation to examine carefully all the other anal valves, and if any of them are likely, from their size and projection, to be torn down and so form other fissures, to snip them off with the scissors.

Non-malignant stricture of the rectum. Varieties.—

Stricture of the rectum must be distinguished from cancerous disease on the one hand, and the pressure of tumours, etc., outside the bowel, on the other. As such it is found following the destruction of tissue, the result of traumatism or ulceration. Spasmodic stricture, in the true sense of the word, is probably unknown, but there are good grounds for believing that a permanent contraction and shortening

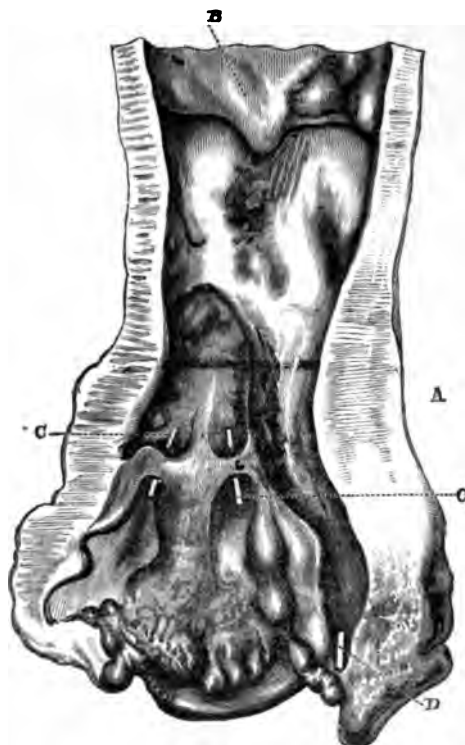


Fig. 840.—Non-Malignant Stricture of the Rectum. (Museum, Richmond Hospital, Dublin.)
 A, Gently thickened wall of the rectum; a, termination of mucous membrane; below this point the entire thickness of the mucous membrane has been destroyed; c, bridges of cicatricial tissue; d, complete rectal fistula.

of the circular muscular fibres above an ulcer may give rise to a definite stricture. Any form of ulceration may originate this condition, but the vast majority are unquestionably due to chancroids or true syphilis.

Morbid anatomy.—In extent a stricture may merely be a ring-like constriction or a long tube-like narrowing, with much infiltration of the surrounding structures, the rectum feeling like a hole bored through a turnip. These are almost invariably found in connection with tertiary syphilis.

Both above and below the strictured point considerable alterations are to be observed in the intestine. Below, we sometimes find polypoid excrescences, occasionally of a considerable degree of density. The mucous membrane is, in the majority of cases, ulcerated, or replaced by cicatricial tissue. In other cases, however, the mucous membrane remains unaltered, and when this is the case it may be taken as evidence of the extrinsic origin of the stricture. The glandular structure of the lining membrane is atrophic, and the openings of fistulæ and internal rectal sinuses are not infrequently met with (Fig. 840).

Of the changes which are to be observed in the bowel above the stricture, generally the most obvious is dilatation, and this may be present to a marked degree. The mucous membrane will frequently be found to have disappeared in patches, as a result of ulceration, and at the seat of these ulcers the wall of the rectum may be so thinned that rupture has taken place.

Symptoms.—The symptoms of non-malignant stricture are generally in the earlier stages extremely vague. The most frequent are attacks of diarrhœa, alternating with constipation, and where these have persisted for some time the suspicions of the surgeon should be aroused, and a rectal examination instituted. The diarrhœa is generally slight, and is more noticeable in the morning: it is frequently associated with the discharge of small quantities of bloody mucus, and brown matter resembling coffee-grounds. This diarrhœa is due to catarrhal inflammation, caused by the irritation of retained fæces above the strictured point, the mucous discharge softening down the fæcal accumulation, and so allowing it to pass the stricture.

Much has been written on the shape of the stools as indicating stricture, but the idea taught in most text-books, that narrow or tape-like fæces are indications of the presence of a stricture, requires qualification. Such an appearance is often produced where no stricture is present, and, on the other hand, a well-formed motion may be passed by a person suffering from marked stenosis, if it is situated sufficiently high to allow the fæcal mass to re-form in the bowel below. Stricture of the rectum, if unrelieved, may produce death by complete obstruction, or perforative peritonitis; while in other cases profuse discharge and local suppuration gradually undermine the patient's strength.

Diagnosis.—Upon making a digital examination, the diagnosis between stricture and narrowing from outside pressure can readily be made, by the freedom from implication of the mucous membrane in the latter case. The diagnosis between benign and malignant stricture may not be so easy.

The following table illustrates the more important points of difference:—

NON-MALIGNANT STRICTURE.

Generally a disease of adult life.

Essentially chronic, and not implicating the system for a long time.

The orifice of the stricture feels as a hard ridge in the tissues of the bowel. Polypoid growths, if present, are felt to be attached to the mucous membrane.

Ulceration of mucous membrane may be present, but without any great induration of the edges.

The entire circumference of the bowel constricted unless the stricture is valvular.

Pain throughout the whole course, in direct proportion to the faecal obstruction, and only complained of during the efforts at defaecation.

Glands not involved.

There is usually evidence that ulceration has commenced at the anus, and travelled upwards.

MALIGNANT OBSTRUCTION.

Generally a disease of old age.

Progress comparatively rapid, and general cachexia soon produced.

Masses of new growth are to be felt either as flat plates between the mucous membrane and muscular tunic, or as distinct tumours encroaching on the lumen of the bowel.

Ulceration, when present, is evidently the result of the breaking down of the neoplasm, and the edges are much thickened and infiltrated.

One portion of the circumference generally more obviously involved.

In the advanced stages pain is frequently referred to the sensory distribution of some of the branches of the sacral plexus, due to direct implication of their trunks.

The sacral lymphatic glands can sometimes be felt through the rectum to be enlarged and hard.

Usually commences well above the anus.

Treatment.—*Dilatation with bougies*, if carefully employed, will add much to the comfort of the patient, but, as in the case of the urethra, they must be employed with a light hand and extreme care. Conical instruments will be found to give the best results, but a patient is never finally cured by this plan; the occasional passage of a full-sized bougie is necessary to maintain the dilatation. The use of all mechanical dilators is extremely dangerous; and the same may be said of internal incision of the stricture, from the ease with which the bowel may be perforated, and faecal extravasation ensue.

External incision, or linear proctotomy, may be adopted in all those cases where gradual dilatation is ineffectual, or where the continued use of the bougie sets up such an amount of constitutional and local irritation that it is inexpedient to continue the treatment.

A vertical incision is made directly backwards into the hollow of the sacrum through the entire length of the stricture, and also through the anus, and the entire wound plugged with iodoform gauze, and subsequently allowed to heal by granulation. As the sphincters and anus are cut through, faecal extravasation does not occur, and the relief to the stricture is complete. Unless, however, bougies are occasionally used subsequently, narrowing may again occur.

Excision of the stricture has been performed several times for the non-malignant stricture, and in suitable cases has much to recommend it. It is preferable to linear proctotomy, both as to the cure of stenosis and the ultimate control of the bowel and general comfort

of the patient. It is performed in the same way as excision of the rectum in cases of cancer.

Colotomy must still be looked upon as the last resort in very extensive cases of stricture where the above treatment has failed or is inapplicable.

Prolapsus recti.—By the term prolapsus, or procidentia recti, is understood the protrusion of portion of the rectal wall through the anus. The old term “*prolapsus ani*,” which is to be found in many text-books, is so obviously erroneous that it is best discontinued. Of prolapsus, we can recognise three distinct varieties:—(1) Where the mucous membrane alone protrudes (partial prolapse); (2) where the entire thickness of the intestinal wall is included in the protrusion (complete prolapse); and (3) where there is invagination as well as prolapse; or in other words, the external appearance of an intussusception.

1. **Partial prolapse.**—When the extruded mass consists of mucous membrane only, the muscular coats of the intestine remaining *in situ*, the condition is spoken of as partial prolapse. This is of somewhat common occurrence, and is a very much less serious affection than either of the other varieties.

A slight protrusion of the mucosa can be produced voluntarily, and normally occurs during and immediately after defæcation. In some animals this is more especially noticeable than in the human subject, the horse being a familiar example.

Causes.—We may conveniently group the causes of pathological prolapse of the mucosa under three heads: (a) that due to the effusion of inflammatory products in the lax tissue of the submucosa; (b) where the mucous membrane is dragged down by piles, polypi, or other neoplasms attached to it; and (c) where the folds of prolapsed membrane have been protruded by peristalsis, the muscular structures of the anus and perinæum being relaxed.

(a) In cases of catarrhal proctitis and dysentery, inflammatory exudations frequently cause the protrusion of bright-red folds of mucous membrane from the anus, but this seldom continues after the inflammation has subsided.

(b) The protrusion of folds of mucous membrane associated with the prolapse of internal piles is exceedingly common, but it seldom occurs to any great extent.

(c) The most important cause in the production of this variety of prolapse is the occurrence of violent and long-continued expulsive efforts, especially if associated with a relaxed condition of the muscles around the anus; consequently we find prolapsus recti a common accompaniment of vesical calculus or phimosis in the child and of enlarged prostate or urethral stricture in the aged, and adult.

Other cases are apparently due to the irritation of intestinal parasites, or of diarrhoea.

This is a disease which is very much more common at the extremes of life, by far the majority of cases being met with in young

children and old people, its primary occurrence between the ages of fifteen and fifty years being quite unusual.

Symptoms.—The diagnosis of this disease is easy, the protrusions of mucous membrane appearing as bright red folds, arranged with sulci between them, which radiate from the aperture (Fig. 841); whereas the sulci in complete prolapse are principally parallel to the anal margin of the bowel (Fig. 842); and, again, in partial prolapse the size of the tumour is usually of much more limited dimensions. The principal masses in partial prolapse are placed laterally; and on the surface of the prolapsed intestine superficial catarrhal ulcerations are frequently to be seen. At first the protrusion only occurs after defæcation, and is easily returnable; in more chronic cases, however, it becomes more difficult to replace, and may reappear independently of defæcation. The mucous membrane also becomes thickened, and the submucosa infiltrated. A muco-purulent discharge is common, and anal bleeding, to a slight extent, often occurs.



Fig. 841.—Partial Prolapsus Recti. (Bryant.)



Fig. 842.—Complete Prolapsus Recti. (Van Buren.)

2. Complete prolapse.

Symptoms.—After partial prolapse has existed for some time, it is apt to merge into the more serious form where all the tunics of the bowel are involved; or sometimes the complete prolapse comes on suddenly, the entire thickness of the rectal wall being protruded by one expulsive effort. When the protrusion reaches any considerable dimensions, it is obvious that the serous coat of the intestine will be involved, and, owing to the

fact that the peritoneal pouch descends much lower on the anterior than on other aspects of the rectum, the first appearance of a sac is to be looked for in front (Fig. 843). If, however, the prolapsus continues to increase in length, so that the upper portion of the rectum and sigmoid flexure become protruded, a peritoneal sac will

be found surrounding the tumour, except where the meso-rectum is attached. Complete prolapse may assume very great proportions; in rare instances the greater part, or even the entire, of the colon being protruded.

It is obvious that where a peritoneal pouch is formed hernia is apt to occur, and even in some cases to become strangulated; while in other very rare instances death has been caused by spontaneous rupture of a large prolapse, or peritonitis may ensue from the ulceration or sloughing of the exposed bowel. The milder cases of

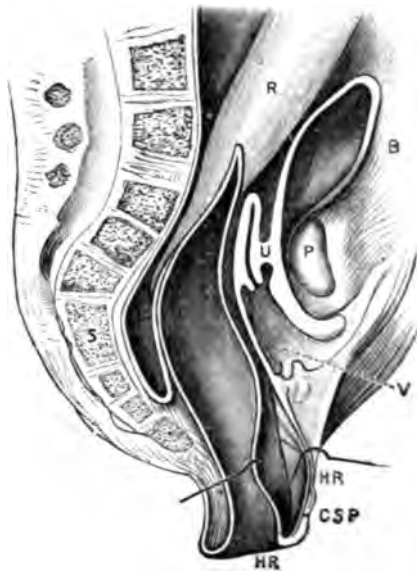


Fig. 843.—Complete Prolapsus in a Child. (Cruveilhier.)

R, Rectum; B, bladder; S, sacrum; P, pubes; U, uterus; V, vagina; HR, prolapse; CSP, peritoneal pouch.

prolapse, especially when occurring in children, tend to recovery with but little treatment; but where the case is one of long standing, and the protrusion voluminous, surgical operation will usually be required.

Treatment of prolapse.—The first step which is usually required in the treatment of this disease is to effect *reduction*. Where the disease has become chronic, or where the submucosa has become distended with inflammatory effusion, considerable difficulty may be experienced in effecting reduction; and in a few very rare cases the hypertrophic changes may be so extensive that it will be quite impracticable to return the mass into the abdominal cavity. In order to effect reduction in the child, the little patient should be laid across the knees, and gentle pressure of the whole mass of the tumour should be for some moments exercised, so as to reduce its bulk by the squeezing out of the contents of the bowel

prolapsed, and of any fluid effusion in its tunics. After this reduction should be proceeded with, efforts being made to return the more central parts first, and in the great majority of cases but little difficulty will be experienced.

Reduction having been effected, it is necessary to apply some *retentive apparatus*. The best temporary means is to apply a pad of tenax, absorbent cotton, or some similar material to the anus, and then to strap the nates together with strips of strong rubber plaster.

In order to prevent the recurrence of the prolapse, great attention must be paid to regulation of the action of the bowels, and the usual sitting position during their evacuation should absolutely be interdicted, defæcation being effected either on a bed-pan, lying on the side, or in the erect position. It is also a useful plan for the patient to accustom himself to have the bowels moved the last thing before going to bed, so that he may at once lie down after the act. This is a good rule in many other rectal diseases, and with a little practice the habit can readily be acquired without discomfort. The anus should be well washed with cold water, solution of alum, or decoction of oak-bark.

Pessaries of various kinds may be tried, but are usually of limited utility. Subcutaneous injection of ergotin, carbolic acid, and other fluids has been recommended, but the results obtained are in every way inferior to the more positive surgical proceedings for radical cure.

The actual cautery is the treatment most generally useful for the purpose of *radical cure*. It has been applied (1) so as to make vertical linear eschars, (2) in isolated spots over the surface of the prolapse, or (3) round the entire circumference of the anus to produce narrowing. The first is the method to be recommended. It is thus described by Van Buren: "Having etherised the patient, elevated the hips as in Sims's position, reduced the prolapse, and introduced a speculum of his pattern of the largest size, proceed to draw a line upon the mucous membrane with the cautery at a dull red heat, parallel with the axis of the gut, and repeat this four or more times at equal distances, carrying the cautery each time from a point three inches or more above the anus slowly down through its orifice, and terminating the line of eschar externally, where the delicate integument covering the sphincter joins the true skin; you will thus have a series of parallel vertical stripes of cauterised tissue, the lower extremities of which will appear as rays diverging from the anus. The lines of eschar may be made more numerous, deeper, and broader, according to the volume and duration of the prolapse. In a child, or where the protrusion is not voluminous, nor of very long duration, I would use a delicate cautery, perhaps not thicker than an ordinary probe, but for a larger tumour in an adult a more bulky iron; but in any case it should be bent nearly at a right angle, a short distance from the button at the extremity, so that it may reach all points of the concavity of the rectal surface."

The after-treatment recommended is to keep the patient confined

to the horizontal position for a week, a bed-pan being employed when the bowels act for at least double this period, to diminish the possibility of a relapse; enemata of tepid water being given when required to assist defæcation. The rationale of this simple operation is easy to comprehend. Any traumatism sufficient to produce inflammatory adhesion between the mucous and deeper coats of the rectum during the process of repair would be sufficient to effect the desired result, but by no method can this be so effectually carried out as by the cautery applied in the way described.

In cases of voluminous and irreducible prolapse where cauterisation has failed, circular resection of the entire prolapse is unquestionably indicated, and quite a number of successful cases have been recorded.

It is probable that excision performed in this way will prove a much safer operation than excision of a stricture, either malignant or benign; for when the operation is performed for prolapse the edges to be sutured together are already in apposition, so that they can be brought together without the slightest disturbance of surrounding parts; while in the other case they are widely separated, and can only be brought together with difficulty. That excision is the best treatment for a very considerable prolapse is, I think, assured, and the success that has attended Whitehead's operation of excision of piles leads one to believe that possibly the minor cases of prolapse may be better treated by excision where the milder and less certain operations might prove unsuccessful.

3. The third variety of prolapse.—This variety, where there appears in the rectum, or through the anus, a portion of the upper sections of the intestinal tract that has become invaginated, can only be briefly alluded to here, and that only so far as the diagnosis is concerned.

These tumours in the rectum have been, not unfrequently, the source of errors in diagnosis, and they have in consequence been removed, the intussusception having been mistaken for a polypus or malignant growth; so that the possibility of a rectal tumour being due to intussusception should be carefully remembered by the surgeon when trying to arrive at a diagnosis.

The important point in the *diagnosis* is the presence of a sulcus between the anal margin and the prolapse. If this exists, it is obvious that the case must be one of intussusception, and if with a finger or ordinary probe the bottom of the sulcus can be reached, it will indicate that the intussusception has taken place in the rectum, a condition, however, which is very rare.

Piles.—Piles or hæmorrhoids, from their extreme frequency, form one of the most important groups of diseases of the rectum, and may best be defined as *tumours originating in a diseased condition of the blood-vessels of the lower end of the rectum, the vessels having undergone dilatation and proliferation.*

Ætiology.—When we come to inquire into the ætiology of this disease, we find that the causes of piles which have from time to time

been given are indeed numerous; and that hæmorrhoids are met with under almost all conditions of life (in the male and in the female, amongst the opulent and poor, the sedentary and active), so that we must look for one common cause, as the most essential, in the production of the same disease in such diverse circumstances. That common predisposing cause is, I feel sure, an anatomical one; and that the erect position occupied by man is the most essential element is, I think, a plausible theory. There is no similar disease, so far as I am aware, known amongst quadrupeds.

The veins of the interior of the rectum all converge to the superior hæmorrhoidal vein, a tributary of the vena portæ. As this system of veins is destitute of valves, and as they leave the rectum by passing obliquely through the muscular coat of the bowel, they are frequently subject to pressure, while obstruction at the liver is also frequent; the tendency to a varicose condition of the rectal veins is therefore obvious; indeed, a dilated state of the small venous radicles situated at the anus may be considered normal.

Piles are essentially a disease of the middle period of life, their occurrence under the age of puberty being extremely uncommon; and when they do occur in children they are generally found to be formed of simply dilated veins.

Pathology.—Various terms have been used to designate the forms of hæmorrhoids. Now although these varieties possess points that render them clinically important, it cannot be maintained that they are distinguished by marked pathological characteristics. When taken broadly, the pathology of all is practically identical—namely, increase and dilatation of the blood-vessels, more particularly the veins, with proliferation of the connective tissue. In the case of *external piles* the covering is the scaly epithelium of the anal canal, while *internal piles* are covered with mucous membrane; but the internal structure of both is alike.

Extravasation of blood is not an important factor in the pathology of piles. In the simple venous external pile, which seemingly appears suddenly, what really happens is this: A varicose condition of one or more of the inferior hæmorrhoidal veins has previously existed without attracting the attention of the patient; from some cause thrombosis and perivascular inflammation supervening, pain is produced; the tumour is noticed; and the patient has what is known as “an attack of piles.” That this is indeed an intravascular, and not extravascular, coagulation of blood can easily be demonstrated. If an incision be made into a simple inflamed external pile a blood-clot can be turned out, leaving a smoothly-surfaced cavity in which an endothelial lining can be demonstrated. Moreover, as a result of stretching of the anus—now the prelude to almost all rectal operations—extravasation of blood is of very common occurrence; yet we invariably see it as a widely diffused ecchymosis, which is rapidly absorbed, and not as a localised blood-clot similar to what we know as an external pile.

That, except in external covering, there is no essential difference in

the structure of an internal and an external pile the specimen figured (Fig. 844) will show. This illustration is from a microphotograph kindly made for me by Professor J. A. Scott.

Here it may be seen that above and below the muco-cutaneous juncture (which is marked by a sulcus) large thrombosed veins (c) are filled with laminated coagula, and between these there is considerable proliferation of the connective tissue, in which moderately large arteries ramify. The mucous membrane (b) covering the internal portion has lost much of its character from frequent prolapse, but is still quite recognisable.

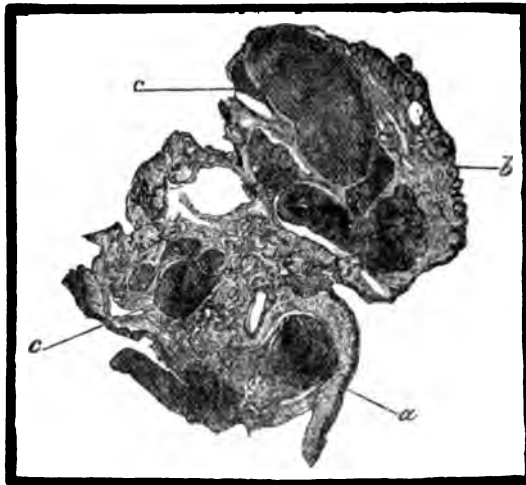


Fig. 844.—Section of Intero-external Pile. ($\times 3$ diameters.)

a, Skin of anal canal; b, mucous membrane; c, laminated blood-clots in the interior of dilated veins.

The determining cause of hemorrhoidal phlebitis is, according to Hartmann and Lieftring,* due to the presence in the interior of the veins of the bacterium coli commune. This opinion is based upon the following grounds:—In sections of thrombi from inflamed piles this micro-organism was invariably found, and it abounded in cultures obtained from the blood-clot; while on the other hand blood taken from uninfamed piles was found quite free from this bacterium, and remained sterile when cultivation was attempted.

Classification.—The classification of piles into external and internal is time-honoured; and as these varieties present many distinct clinical features, the terms are best maintained, although it is by no means uncommon to find both varieties associated in a given case. By *external piles* we understand those which are covered by the skin of the anal canal, while those which are situated above the anal canal, and consequently have a covering of mucous

* *Bull. de la Soc. Anat. de Paris*, Fascic. No. 3, 1892.

membrane, are called *internal*; and where an external pile is directly continuous with an internal one across "Hilton's white line," without any sulcus existing between the two, it is called *intero-external*. Of external piles several varieties have been described, but for practical purposes the division into *venous*, *cutaneous*, and *compound* will suffice.

External piles.—The essential element in the production of a *venous pile* is a varicose condition of the inferior hæmorrhoidal veins, which is predisposed to by any of the causes before named. As long as the vein remains pervious and free from phlebitis, the patient is free from discomfort, and may be ignorant of the existence of the disease. When, however, thrombosis takes place, or the swelling becomes acutely inflamed, the pain is severe, and attended with considerable constitutional disturbance: the tongue becomes furred, the febrile condition being quite out of proportion to the local cause; the skin in the neighbourhood becomes inflamed and swollen; spasmodic contractions of the levator ani and sphincters add much to the patient's suffering, this being peculiarly annoying just when he is going asleep, the violent contractions and acute pain completely waking him up; there is a sensation as if there was a foreign body in the rectum, producing tenesmus and painful strainings; the symptoms are all aggravated by walking or by any sudden contraction of the diaphragm, as in coughing, sneezing, etc.; constipation is usually present, and when the bowels do move, the pain at the time and for some hours afterwards is much increased. Such is the train of symptoms that characterise what is known as an acute "attack of piles." If an examination be made of a patient in this condition, one or more livid tumours, varying in size from a pea to a filbert, will be seen in the neighbourhood of the anus. These are acutely sensitive, and have a tense glistening surface; pressure fails to empty the blood out of the tumour, thrombosis of the varicose veins being the first element in the production of an attack of external piles.

The second variety or *cutaneous pile* is not infrequently a sequence of the first, the inflammation surrounding the thrombosed vein producing hyperplasia of the connective tissue and skin, constituting a tumour, usually of small size and pale colour. This may become somewhat pedunculated, being attached by a narrow neck, while more commonly it is found with a broad base of support, the hypertrophy of the skin being confined to the radiating folds that normally surround the anus.

Compound external pile is usually of considerable size, about as large as a filbert, with smooth surface, and very prone to inflammation; if incised in the usual manner it is found to consist principally of connective tissue, and contains several thrombosed veins of considerable size, instead of one central cavity, as in the common variety of venous pile. It is found in persons who have suffered from repeated attacks of inflamed external hæmorrhoids, and is almost always placed laterally, the long axis being antero-posterior.

Cutaneous piles are apt, from local inflammatory causes, to become œdematous; they then become much increased in size, smooth and shiny on the surface, and acutely painful. This inflammatory swelling usually subsides in a few days, leaving the pile somewhat permanently increased in size; or suppuration may result.

While free from inflammation, external piles give rise to but trivial annoyance, caused by the mechanical inconvenience due to their size; but when inflammation supervenes, the pain becomes extremely severe, so that the strongest man may be thereby quite incapacitated for any active employment.

Hæmorrhage from external piles is an unusual occurrence and is not generally severe.

Suppuration is a very common termination to an attack of inflamed external piles and, when it occurs, tends to the production of a complete spontaneous cure. In rare cases, however, the abscess cavity opening in a second place, a small marginal fistula forms.

Treatment of external piles.—The treatment of external piles is usually sufficiently simple. It may be divided into the palliative and radical; the latter of these is in nearly all cases preferable. If, however, the patient will not submit to the trivial operation necessary, recourse must be had to local applications during the period of acute inflammation. Of the *palliative treatments*, the best, in my opinion, is the application of a mixture of extract of belladonna and glycerine smeared over the part, and followed by a warm stupe. At the same time the bowels should be freely cleared, and a light, unstimulating diet, with rest in bed, prescribed. The inflammation will then usually subside in a few days, but it leaves behind a thickened projection of skin ready at any time to inflame again on the slightest provocation; or, if suppuration occurs, the cure may be radical, but only at the cost of much unnecessary suffering.

The *radical cure* may be accomplished either by incision or excision. When the pile consists of a simple thrombosed varix, treatment by *incision* and turning out the clot is indicated; it is quite unnecessary to wait for the subsidence of inflammation. *Local* anæsthesia by cocaine or ether spray is usually sufficient; the cavity should be filled with boric acid powder, and the patient kept quiet for a few days. The relief is usually immediate and recovery rapid.

Excision undoubtedly is the form of treatment of most general applicability. It is better to give the patient a general anæsthetic as the pain is considerable; and in performing the operation, the surgeon must be careful not to cut away the folds of skin about the anus too freely, else an anal stricture may be the unpleasant result. Only the distinct tumours should be dealt with, and of these only about two-thirds of each should be removed. The bases will then shrink and all danger of stricture will be obviated. Since œdematous folds of skin need not be interfered with, as they quite subside when the source of irritation is removed.

In the treatment of large and compound piles I have often found it a good plan to bring the cutaneous edges of the wound together with a few points of catgut suture. By doing so, healing will usually be much more rapid than if the surface is left to granulate. After the operation is completed the surface of the anus should be well dusted with boric acid, and an antiseptic pad firmly applied.

Internal piles.—Many varieties of internal piles have been described, varying from a highly vascular patch of mucous membrane (the *nævroid*) to the large fleshy mass occupying one of the columns of Morgagni (the *columnar*). The classification has, however, no pathological basis, and is clinically unnecessary.

Of the *symptoms* of internal piles, the most important, and frequently the first, to attract attention is bleeding. So constant is this symptom that the terms "bleeding" and "internal" piles are practically synonymous. It is very rarely that the disease has existed for any time without this symptom being marked. It is at first only at stool that this loss of blood is noticed, the tender and highly vascular mucous membrane being bruised and lacerated by the passage of a hard *fecal* mass, the blood continuing to drip from the anus for some time after the rectum has been evacuated. As the disease progresses the bleeding becomes more frequent, till it occurs daily after each evacuation of the bowels; indeed, in extreme cases it is not confined to the act of defecation, but comes on at irregular times, without any apparent exciting cause.

The amount of blood which may be lost in this way is occasionally very great, and in certain rare cases a fatal syncope has undoubtedly been produced. As seen after a motion has passed, the blood will not be intimately mixed with the *feces*, and will be of a bright red colour; in this way it can be easily distinguished from blood from the higher portions of the intestinal tract.

Mucous discharge is commonly present, either alternately with bleeding, or replacing it altogether.

Except when strangulated or acutely inflamed, pain is not a prominent symptom of internal piles; nevertheless, a certain amount of uneasiness or discomfort is generally present, with a sense of fulness and weight in the pelvis; and reflex pains at a distance from the anus are not uncommonly complained of. In cases of old-standing piles, prolapse sometimes occurs independent of defecation, and it then becomes extremely uncomfortable for the patient until it is returned (Fig. 845).

Piles are frequently associated with other diseases, notably of the heart and liver, while they may be symptomatic of stricture of the rectum or other pelvic disease. It is, of course, essential to bear these facts in mind when examining a case, and where cardiac disease or hepatic obstruction is much in evidence, it may be well, unless the bleeding is severe, to leave the piles alone; and, of course, where piles are merely symptomatic of stricture or other pelvic disease, their simple removal will not cure the patient.

Strangulation and gangrene of internal piles may arise from

one or two quite distinct conditions. Either the piles may be extruded from the anus, and caught by the sphincter, or inflammation may be started from some trivial abrasion, and, owing to the extreme vascularity of the part, gangrene may rapidly ensue.

From whichever cause arising, the pain will be very severe, and the constitutional disturbance considerable. Spontaneous cure in this way sometimes results, but usually it is incomplete. If due to nipping of the sphincter, an attempt at reduction should be made, pushing up the most central portions first; if, however, there is much inflammatory thickening around the anus, this will be impossible, and complete removal by operation is indicated.

Treatment of internal piles.—The treatment of internal piles may be classified into the palliative and radical. Unquestionably, in some cases, the *palliative treatment* will be followed by complete immunity from further trouble; yet these cases are quite the exception, and where the piles are large and attended with the formation of much new tissue, it can hardly be expected that anything short of some surgical operative procedure will effect a cure.

The most important indication to be fulfilled in the treatment by medical measures is the regulation of the bowels. If allowed to become costive, the piles are liable to be excoriated during defecation, and increase of bleeding and possible subsequent inflammation are the necessary result; whereas, if an easy and soft evacuation is secured each morning, a state of comparative comfort can be maintained.

If constipation be present, sulphate of magnesia, with sulphate of soda, taken before breakfast, and the occasional use of an aloetic pill, are the best purgatives; whilst the rectum should be washed out daily with a small enema, and, after defecation, the anus thoroughly washed with cold water. If bleeding be considerable, suppositories containing tannic acid or dried sulphate of iron may be used, or the same drugs in ointment rubbed over the piles when prolapsed, or introduced into the bowel with an ointment introducer.

The more important *operations for the cure of internal piles* may be usefully enumerated under the following heads: (1) the application of chemical caustics to the surface of the tumours; (2) the injection of fluids of various kinds into the interior of the growths; (3) the gradual or forced dilatation of the anal sphincters; (4) electrolysis; (5) ligature; (6) crushing; (7) excision; (8) the actual cautery.

(1) Amongst *chemical caustics*, the most frequently used has been nitric acid, applied through a speculum or to a prolapsed pile. That this treatment has proved effectual in stopping bleeding from small and very vascular naevoid piles is undoubted, but it is vastly inferior to the more positive and more scientific treatment at the disposal of the modern surgeon. The use of the more potent caustics, such as butter of antimony or caustic potash, the relics of a bygone surgery, is absolutely inadmissible.

(2) *Injections of various fluids* into the interior of piles by means of a hypodermic needle, is a treatment that has been revived in America. Carbolic acid, perchloride of iron, extract of ergot, and tannic acid are the drugs which have chiefly been used; more especially carbolic acid in solution (15 to 50 per cent.), of which two or three drops are injected into the interior of the pile with an ordinary hypodermic needle. The treatment has to be frequently repeated, and is usually unsatisfactory; however, where a patient refuses to have an anæsthetic and undergo any of the more radical operations, it may possibly be of use.

(3) *Forced dilatation of the anus*.—A most useful prelude to many surgical operations on the rectum, especially the ligature or excision of piles, has been credited with effecting a cure without any further operation, especially by French surgeons. It is hard to imagine how such can be the case, and, as in itself it necessitates an anæsthetic, it is better to make certain of the cure by ligature or excision after the dilatation has been accomplished.

(4) *Electrolysis* is only suitable for small piles; but as it does not require general anæsthesia or confinement to the house, it can often be employed with advantage if the necessary apparatus is at hand. The way in which I employ it is as follows:—The pile being brought into view, the surface is well painted over with a solution of cocaine hydrochlorate (4 per cent.), and after the lapse of five to ten minutes, four or five round sewing needles, mounted in a handle, are passed into the centre of the tumour, and connected with the *negative* pole of the battery, 10 to 20 Leclanché elements being the most suitable, the other (positive) pole being applied by means of a wet sponge to the buttock. After a few minutes the surface of the pile will be seen to become white, and minute bubbles of hydrogen gas will be seen escaping round the needles. As soon as this is well marked the needles are withdrawn, and, if deemed necessary, reintroduced into another part of the same, or another pile. In a few days the piles shrivel up and disappear painlessly.

(5) *Ligature*.—Without doubt ligature, in some of its modifications, has been the most popular method of treating internal piles, and is by far the most frequently employed. Dating, as it does, back to the time of Hippocrates, it still retains with the majority of surgeons its popularity as one of the best methods of treatment; while with a few it appears to be employed to the exclusion of all other plans.

Unquestionably the best way of applying the ligature is by the method introduced at St. Mark's Hospital by the late Mr. Salmon. It is best performed as follows: The patient should beforehand have the bowels well relieved by taking an efficient purgative, and immediately before the operation the rectum should be well washed out with a copious soap and water injection. An anæsthetic should now be administered, and the patient placed in the semi-prone position of Sims, or in the lithotomy position. I prefer the latter, and employ Clover's crutch for retaining the patient conveniently. If during the

administration of the anæsthetic the piles have become retracted within the anus, no uneasiness need be experienced, as they can be readily brought into view again. The anus should now be carefully stretched by the introduction and gradual separation of both index fingers. As the strain is kept up, the sphincter muscle is gradually felt to relax, and after a minute or two will be found to have lost its tendency to contract. If it is felt relaxing suddenly, great caution is indicated, as laceration is imminent. The entire rectum can by this means be explored, and the lower portion brought well into view. The surgeon should now decide on the number of piles which require



Fig. 845.—Prolapsed Internal Piles.

removal, and in doing so it is well to remember that internal piles may be much more freely removed, without fear of stricture, than those covered by skin, and surrounding the anus. All distinct tumours, and portions of spongy and thickened mucous membrane should be removed, and the best way is to fix on each condemned piece one of the spring-catch forceps, so commonly used for hæmorrhagic purposes, and let them hang down in a cluster; in this way there is no danger, when afterwards the parts become obscured with blood, of smaller piles being overlooked or forgotten. Taking up one of the forceps with the left hand, and gently pulling on it, the base of the enclosed pile is made tense, and an incision is made with a scissors at the junction of skin and mucous membrane; and then, by a series of snips, all the lower attachments of the pile are severed, and it is dissected up until it is attached only by healthy-looking mucous membrane above and the vessels going down into it. During

this dissection the bleeding will be but trivial, as the main vessels enter from above, and remain undivided in the pedicle. The forceps is now handed to an assistant to make light traction, and a stout ligature is placed round the pedicle and tied very tightly; if tied so tight that the growth is absolutely strangulated at first, much trouble and discomfort during the after treatment will be avoided. Unless complete strangulation has been assured the central portion of the ligatured mass may regain vitality as soon as the constriction by the ligature diminishes; by its cutting into the tissues, this leaves a polyp-like mass, which usually requires a subsequent operation for its removal. It is better to operate first on the piles which are situated *lowest* as the patient lies, as by this means the further steps of the operation are less obscured by bleeding. The remainder of the forceps are now taken up one by one, and the enclosed piles similarly treated. It is seldom that more than five require ligature, and often only one or two. The ligatures may now be cut off short, and also the piles in front of the ligatures, taking care to leave enough to prevent slipping. This excision also has the advantage of showing whether the ligature has been sufficient to produce complete strangulation. The parts should now be well dusted with boric acid, a morphia suppository ($\frac{1}{4}$ grain) introduced, and an antiseptic pad firmly applied to the part.

(6) *Crushing* by means of a powerful clamp, so that the vitality of the piles is at once completely destroyed, was introduced by Mr. Pollock,* and various clamps for the purpose have since been devised. The steps of the operation are similar to the method of ligature above described, except that instead of the ligature the clamp is used to crush the pedicle. When thoroughly performed, the results are satisfactory.

(7) *Excision*, as recommended by Whitehead,† is unquestionably the best operation for severe cases of internal piles, as it completely removes the total pile-bearing area of mucous membrane, and is therefore a truly radical cure. The following method, which is a slight modification of that described by Whitehead, will be found to answer well:—In the first place it is necessary to understand clearly where the circular incision through the skin of the anus is to be situated; indeed there appears to be some considerable ambiguity about what is meant by the *margin* of the anus in describing any pile operation. If the reader will refer to Fig. 845 he will see that the prolapsed mass consists of two more or less concentric rings of tissue. The inner of these is formed by the internal piles proper, while the outer is the extroverted skin of the anal canal, with possibly some external piles. Even where there are no external piles, the extroverted anal canal forms a definite thick ring round the internal piles when they become prolapsed. Occasionally, as a result of forcible dilatation

* *Lancet*, July 3, 1880.

† *British Medical Journal*, February 26, 1887.

preliminary to operation, subcutaneous extravasation of blood makes this ring swell up to a considerable size. It is necessary clearly to understand that the anus is not merely an orifice, it is a canal about one inch long in the adult, and that when internal piles are protruded, extroversion of the canal takes place. When speaking of the margin of the anus some surgeons mean the outer circumference, while others undoubtedly mean the inner circumference of this ring. It is obvious that there is a wide difference in the result of operations according to which interpretation is put on the word margin. The outer circumference corresponds with the lower outlet of the anal canal, while the inner is at the muco-cutaneous junction. I am decidedly of opinion that the best position for the incision in the operation of excision of piles lies between these two lines. In consequence of repeated prolapse of piles with extroversion of the anal canal the skin lining this canal becomes somewhat redundant, so that if the incision is carried round exactly at the muco-cutaneous junction rather too much skin is left. This is not a matter of much consequence if primary union follows, but if the edges do not at once unite, the skin margin is apt to become everted and leave troublesome little tags of external piles. If, on the other hand, the entire skin of the anal canal is removed and primary union results, some of the mucous membrane is left exposed and causes irritation when the clothes rub against it, whereas if the primary union does not take place and the wound heals by granulation, stricture of the anus to an unpleasant extent may result.

I would recommend the circular incision to be made at the most dependent portion of the prolapsed anal canal; this leaves quite two-thirds of this structure, but removes all the little irregularities of the muco-cutaneous junction. For this purpose sharp-pointed scissors is the best instrument.

Having made a clean cut round the entire circumference, the diseased tissue is rapidly separated from the external sphincter and muscular coat of the rectum, and the separation is carried up until quite above the piles all round. Catch forceps may be applied to any large bleeding vessels. The mucous membrane is now cut through circumferentially bit by bit, one portion being accurately adjusted to the skin before the next piece is cut. I find fine catgut hardened by being preserved in absolute alcohol the best suture material; and it is a good plan to carry the needle twice, once rather deeply and then merely through the edges of skin and mucous membrane respectively, before tying the knot of the suture. If care be taken in passing the deeper portions of the suture, bleeding will be completely arrested, and ligatures to the arteries or torsion will be unnecessary. After the entire circumference has been in this way sutured, any bleeding that may remain can be completely arrested by the application of one or two additional points of interrupted suture passed deeply. The anus should now be covered thickly with boric acid, some of this powder being placed within the rectum and a firm antiseptic pad and bandage applied.

(8) *Actual cautery*.—Some years ago the actual cautery, guarded by the use of a properly constructed clamp to limit the action of the cautery, was revived, and largely used, the clamp being employed in the same way as the crushing clamp, and the protruding pile burnt off, thus obviating the risk of hæmorrhage. The method, however, presents no advantages over the more exact and scientific methods already enumerated.

In conclusion, it is advisable to excise all extensive cases of piles,



Fig. 846.—Adenomatous Rectal Polypus. (Natural size.) (Pozzi.)

to ligature them when few and isolated, and to employ electrolysis or nitric acid with very small and vascular nævoid growths.

After treatment.—Pain should be controlled by opium, which also has the advantage of keeping the bowels confined for a few days. It is well to give a purgative on the fourth day. The dressing throughout should be boric acid or other antiseptic, and an absorbent pad kept in place by a bandage. Hæmorrhage either into the bowel or externally, if severe, necessitates immediate action. In the first instance ice, or plugging the rectum with strips of iodoform gauze, may be employed; but if it goes on to a dangerous extent, it is better to give an anæsthetic again, dilate the anus, and ligature or suture up the bleeding point. Retention of urine for the first day or two is occasionally troublesome, requiring the use of a catheter. Ligatures, if properly tied, should come away at the end of the first week, and

the remaining sores heal up in another week. The mortality after pile operations is extremely trivial—a very small fraction of 1 per cent.—and the comfort following a thorough operation is very great.

Benign neoplasms of the rectum and anus.—The word “polypus,” which has descended from a remote period of surgical history, is used with much vagueness in reference to all parts of the body; but in none is it more noticeable than in the rectum: by what process I know not, it has come to be used as a term for any neoplasm attached by a narrow pedicle. And as the greater number of benign neoplasms of the lower bowel answer this definition, the term “rectal polypus” is held by many writers to include the

various pathological formations included under the heading of this section. As, however, the term is generally used, it would be inconvenient to discontinue it, and when used, it must simply be held to imply that the growth alluded to is more or less pedunculated.

Varieties.—The principal forms of benign neoplasms met with in the rectum belong to one or other of the following varieties of outgrowths (or so-called polypi), viz.: (1) adenoma; (2) fibroma; (3) papilloma; (4) teratoma; (5) lipoma; (6) cystoma; (7) chondroma; (8) angioma; (9) myoma; (10) lymphoma.



Fig. 847.—Multiple Polypi of Rectum. (Museum, King's College Hospital.)

1. **Benign adenoma** is one of the forms most frequently met with, and is especially found in young children, but at the same time it cannot be said to be a common affection, unless, indeed, as is possibly the case, many instances undergo spontaneous cure without coming under the notice of the surgeon. In size these polypi vary from that of a pea to that of a walnut, although sometimes they may attain a much larger size, as in Fig. 846.

The surface is usually irregularly lobulated, and, when looked at closely, appears roughly granular. It is attached to the wall of the gut by a narrow pedicle of mucous membrane, which contains the vessels for the supply of the growth. These are sometimes of considerable size, so that arterial pulsation can be felt with the finger; the colour is usually bright red, but if the growth has been caught by the sphincter, it may be livid from congestion, or even gangrenous. Although usually single, adenomata may sometimes be more numerous, while in comparatively rare instances the entire surface of the colon may be covered with them (Fig. 847).

Mode of formation.—Fig. 848 represents a section of an adenoma that was taken from a child who came into hospital with a prolapse, at the apex of which two small polypi were forming, but as yet no pedicles had appeared; it shows well the method of formation of an adenoma. A radial section has been made through the centre of the hilum and through the mucous membrane on each side of the polyp; on the right side (at *c*) the section has passed vertically through mucous membrane, while on the left side (*d*) the mucous membrane has been cut horizontally; the section also traverses a solitary gland (*e*). The figure is from a micro-photograph kindly

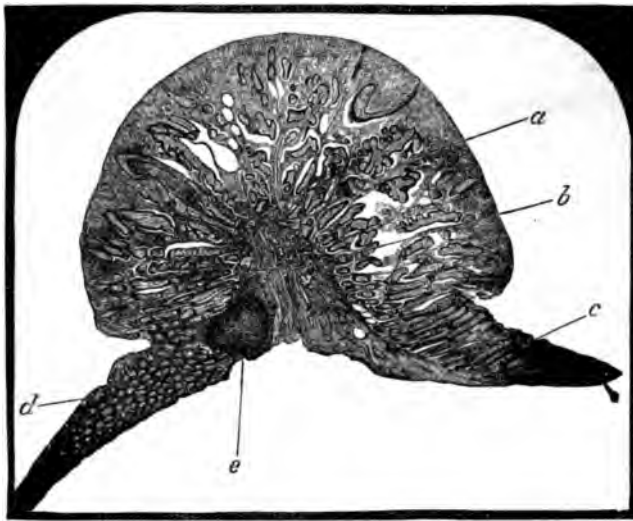


Fig. 848.—Adenoma of Rectum. ($\times 10$ diameters.)

a, Glandular structure; *b*, hilum of connective tissue and vessels; *c*, mucous membrane cut longitudinally; *d*, mucous membrane cut transversely; *e*, solitary gland.

made for me by Professor J. A. Scott. The first step in the production of polypus is an increase in length and hypertrophy of the follicles of Lieberkühn (*c*, Fig. 848), and at the same time the columnar cells lining these tubes become elongated and enlarged. The result of this is that the mucous membrane at this point buckles up and projects as a tumour. As the follicles become increased in number and size they become more and more convoluted. The tumour now offers some resistance to the passing mass of fæces, and becomes dragged down, the circular fibres of the bowel also assisting to expel the tumour. The pedicle of mucous membrane is thus formed.

If a section be made passing through the hilum of one of these little growths, it will be found that, starting from that point, bands of connective tissue radiate in all directions to the circumference

of the polypus, and between these are numerous secondary offshoots; the little spaces thus left are packed with Lieberkühn's follicles considerably larger than normal; the section appears as if these were closed cavities, but in all probability this appearance is produced by the line of section traversing convoluted tubes, and this probability is rendered greater by the fact that numbers of these tubes open on the surface of the polyp, the roughly granular aspect of which is due to the numerous orifices.

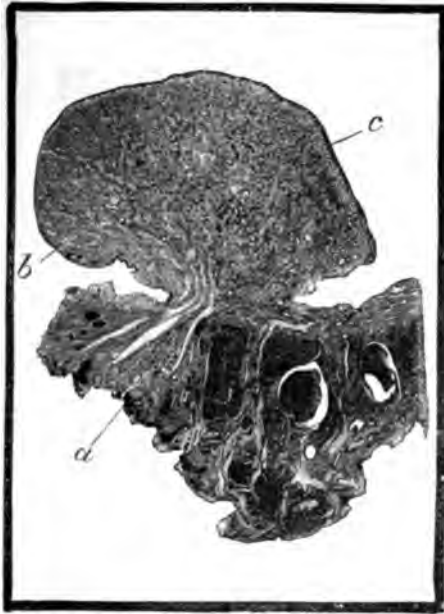


Fig. 849.—Fibrous Polypus of Rectum. ($\times 24$.)
a, Haemorrhoidal structure; b, fibrous tissue c, altered mucous membrane.

Symptoms.—Unless when it is attended by some of the above complications, polypus, when situated high up, is marked by no definite symptoms; when, however, it is attached low down, or comes to touch the anus by gradual elongation of the pedicle, its presence gives rise to some sensation of fulness and distress in the lower bowel; and, as a result, constant efforts at expulsion, with tenesmus, are present; there is more or less discharge of glairy mucus, and, if the growth has come low enough to be nipped by the sphincter, bleeding will result: in fact bleeding is frequent the first indication the presence of a polypus, and, in child

especially, rectal hæmorrhage is strong presumptive evidence adenoma. A digital examination will readily confirm the diagnosis.

Treatment.—Small polypi situated near the anal margin may with safety be twisted off with a catch forceps, but those attached higher up should always be ligatured and snipped off. This is especially necessary where the tumour is large and the pedicle, as, in addition to containing a tolerably large vessel, the thickness of the rectal wall may be invaginated in it, carrying it, possibly, a process of peritoneum.

2. **Fibroma.**—Tumours of the connective-tissue type are sometimes found in the rectum, attached by pedicles, and consist of some of the varieties of the so-called fibrous polypi. These growths so frequently found in connection with fissure, and

at its lower extremity, are of this nature, but in many cases I have no doubt that the origin of fibrous polypus is directly from internal piles. If a series of cases of internal piles are examined it will be



Fig. 850.—Papilloma of Rectum. (Natural size.) (Museum, University College Hospital.)

found that fibroid change gradually takes place and becomes more marked in proportion to the duration of the disease, until finally the dilated veins entirely disappear, nothing but soft fibrous tissue

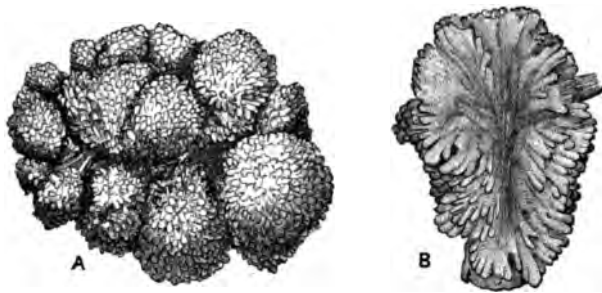


Fig. 851.—Anal Papilloma.
A, Surface; B, section of anal papilloma.

remaining. When this has occurred the tendency of the growth is to become pedunculated. Fig. 849 represents a case of this kind: in the upper portion is a typical fibrous polypus, attached by a broad pedicle to ordinary pile structure; it was removed with four other similar growths from the rectum of a woman who had suffered from

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piles for upwards of twenty years. I have a series of pile sections taken from a large number of different cases, showing all gradations of this fibroid change, by which an internal pile becomes a fibrous polypus. The clinical evidence of this change is in the colour and texture of the pile, both of which gradually become modified. Where very old piles exist the bright red colour is lost, and when the fibroid change is complete they assume a yellowish-white appearance, the mucous membrane becoming more like skin, at the same time they become firmer and more solid to the touch.

The removal of the growths is to be conducted on the same lines as operations for internal piles.

3. **Papilloma.** ["Villous tumour of rectum" (Curling); "villous polypus" (Esmarch); and "granular papilloma" (Gosselin).]—Under these various terms is described a remarkable but rare form of rectal growth, resembling in general appearance the villous tumour of the bladder, with this slight difference, however, that the lobes in the bladder tumour are more filiform, while in the rectum they are flattened or club-shaped (Fig. 850). They are composed of the papillæ of the mucous membrane, which have proliferated freely, and are covered with columnar-celled epithelium; they are attached to the wall of the bowel by a more or less broad pedicle, but occasionally are sessile.

They give rise to a great deal of bleeding and mucous discharge, and when low down may be troublesome, owing to their protrusion at stool.

They are to be removed in the same way as other polypi—i.e. by ligature and subsequent excision.

Papillomata of the anus (Fig. 851) differ from the variety just mentioned by having a covering of squamous instead of columnar epithelium. Probably they sometimes originate, like warts on the penis, from the irritation of gonorrhœa or other acrid discharge, while at other times they certainly appear to form without any such apparent cause.

Upon microscopical examination anal papillomata present similar characters to those met with in other regions of the body, where the covering is of scaly epithelium. The "cauliflower-like" appearance is due to the numerous sulci between the papillæ.

Other forms of benign neoplasm.—The other varieties of benign rectal neoplasms—teratoma, lipoma, cystoma, chondroma, angioma, myoma, and lymphoma—although pathologically of great interest, are so rare, that it is unnecessary to enter fully into a description of them in a text-book of this kind. For a complete account of them the reader must be referred to the special monographs on rectal disease.

Malignant neoplasms of the rectum and anus.—Of the various new growths which are found in the rectum, and which are clinically malignant, columnar-celled epithelioma, or, as it is sometimes called, "malignant infiltrating adenoma," is unquestionably the most common. The other varieties of carcinomata and sarcomata

are only met with very occasionally; but as it is sometimes quite impossible to differentiate these varieties *clinically*, it will be convenient to retain the term "cancer," using it in its broadest sense, as synonymous with all the forms of malignant tumour, whether histologically of epithelial or connective tissue origin.

General characters of rectal cancer.—The clinical differences between the simple adenoma, or mucous polypus, of the rectum,

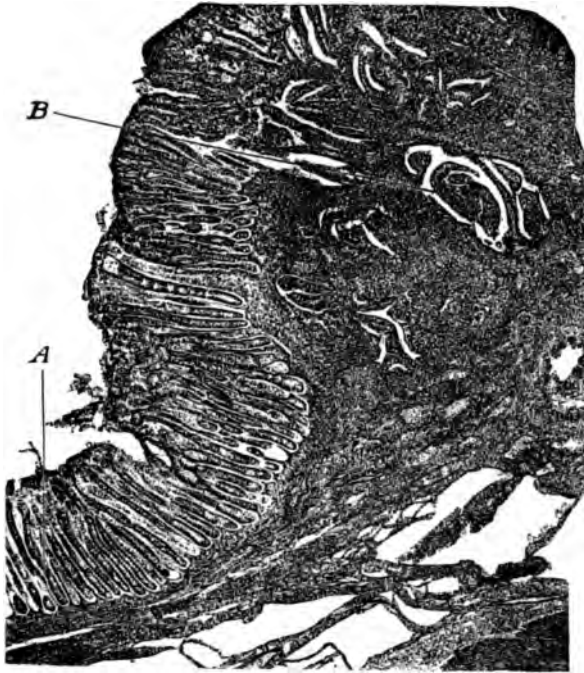


Fig. 852.—Margin of Cancerous Nodule. (From micro-photograph.) ($\times 10$.)
A, Normal mucous membrane; B, infiltration of muscular structure by glandular tissue.

and cancer of that organ, are sufficiently obvious: the simple adenoma generally occurring in young persons, being attached by a long pedicle, not tending to recur after removal, or to affect the constitution: the cancer, on the other hand, is sessile, tends to infiltrate deeper parts, to break down and ulcerate, to affect profoundly the constitution, to recur after removal, and produce metastatic growths of similar character at a distance from the original site.

Now when these growths are examined under the microscope, they both consist essentially of the same tissue, namely the glandular structure of the mucous membrane, such as is normally found lining the Lieberkühn follicles of the intestine; the only difference being that in the benign form there is a tendency to project into the

lumen of the bowel, and to draw down a pedicle of normal mucous membrane, while in cancer the wall of the intestine is from the very first infiltrated with the new formation. First the muscularis mucosæ becomes perforated, then the submucosa is invaded, and afterwards the muscular coat itself is infiltrated (Figs. 852, 853), so that the only histological difference between these growths is really one of situation, and of relation to surrounding tissues, not of structure.



Fig. 853.—Cylinder-celled Epithelioma of Rectum. ($\times 10$.)

A, External muscular coat of bowel; B, internal muscular coat of bowel; C, masses of glandular tissue separating the bundles of muscular fibre of the internal muscular coat.

When cancer primarily attacks the *anus*, as might be expected, the bulk of the tumour is composed of scaly epithelium, and the growth resembles that met with in the lip. It does not very commonly occur.

Besides the infiltration of surrounding structures, rectal adenocarcinoma tends to reproduce itself in other parts of the body; and like all the group of the carcinomata, the lymphatic glands become implicated with extreme frequency. When, as is usually the case, the disease is situated entirely within the rectum, leaving the *anus* free, the first to be involved will be the pelvic and lumbar glands;

and sometimes these are seen to be of very large size, the glands along the iliac vessels being sometimes quite as large as hen's eggs, and capable of recognition during life by abdominal palpation. Next in order the lumbar glands are enlarged; but the lymphatics of the groin only become implicated as a consequence of involvement of the external skin of the anus, or when, in an advanced stage of the

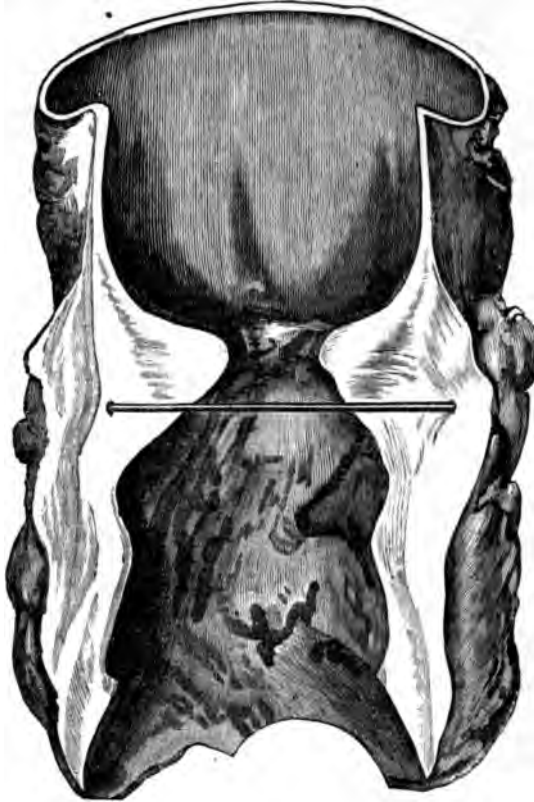


Fig. 854. —Case of Colloid Cancer of Rectum, removed by trans-sacral incision. (Natural size.

disease, a very widespread lymphatic implication follows the enlargement of the pelvic glands in cases of adeno-carcinoma. Next in frequency to the lymphatic system, the new growths are liable to be found in the liver, probably the most frequent cause of disseminated hepatic cancer being the form of disease under consideration. As is usual with metastatic tumours, the secondary growths reproduce with singular exactness the histological characters of the original tumour. Involvement of the peritoneum also is not infrequent, the metastatic growths appearing like grains of boiled sago over the

surface, and, when extensive, matting together the coils of small intestine. Secondary deposits have also been found in the pancreas, lungs, etc.

Colloid or gelatinous cancer is occasionally met with in the rectum, it may occur as a definite tumour, or as a diffuse infiltration,

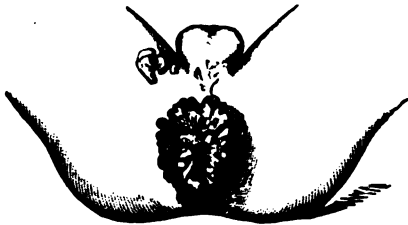


Fig. 855.—Large Sarcomatous Tumour of Anus and lower part of Rectum, with secondary tumours on the inside of the thigh. (Museum, Royal College of Surgeons, Ireland.)

and is characterised by the translucency of its substance. The stroma contains, instead of closely packed masses of epithelial cells, a more or less clear jelly. The colloid or gelatinous texture of the tumour is due to mucoid or colloid change affecting the cancer cells.

Of colloid cancer I have had two well-marked cases in my practice. The first

formed a tubular stricture about four inches long, commencing immediately inside the anus (Fig. 854). The lower portion was much ulcerated and the intestine above considerably dilated; it was removed from a woman aged thirty, by trans-sacral incision. She made an excellent recovery, and so far remains free from recurrence.

The second case was that of a man, aged sixty, in which the disease appeared as a nodule at the upper extremity of a cicatrix, following a very extensive operation for rectal fistula; this was also successfully excised.

Rectal sarcomata.—The second great class of malignant neoplasms, coming, in order of frequency, after the carcinomata, are those tumours the bulk of which are composed entirely of embryonic connective tissue, but sarcomata are rare in the intestinal tract.

In the museum of the Royal College of Surgeons of Ireland are two very remarkable examples of sarcomatous growths. In the first (Fig. 855) there is projecting from the anus an enormous mass, which measures five inches by four; it is much lobulated on the surface, presenting somewhat the appearance of an ordinary papilloma of this region. It differs, however, in this, that the individual lobules are much larger, and the intervening depressions much shallower; a small group of secondary growths appears near the scrotum, in the skin of the thigh, and the disease extends up into the rectum for a distance of about two inches. There does not appear, however, to have been any obstruction, as the tube was quite pervious behind the growth. There is, unfortunately, no very reliable history with this specimen. Dr. P. S. Abraham, the late curator of the museum, kindly undertook a detailed examination, and he made microscopic sections from the mass inside the rectum, from the external growth, and from the secondary formations. In all of them the appearances were practically identical; there was no

trace of proliferating mucous membrane, almost the entire of the sections consisting of small spindle cells, with but little fully-developed connective tissue.

The second specimen (Fig. 856) is one in which a long tubular rectal stricture exists, commencing about one inch inside the anus, and extending upwards for a distance of five inches. All the coats of the bowel appear to be lost in the growth which surrounds the intestine evenly, and which measures one inch in thickness at the middle portion. Above the neoplasm the intestine is widely dilated, showing very clearly that during life the degree of obstruction must have been considerable.

Melanotic sarcoma.—Primary melanotic cancer of the rectum is extremely rare, and according to Virchow this is the only portion of the intestinal tract in which it has been found. He has also pointed out the remarkable fact* that intestinal melanosis, which is such an extremely rare disease in the human subject, is met with frequently in the horse.

I have met with one well-marked case of primary melanotic sarcoma of the rectum.

Symptoms of rectal cancer.—As in cancer of other parts of the body, pain is a prominent symptom at a certain period of the disease, but in the early stages it is in many instances exceedingly slight; this is so as long as the disease is confined to the interior of the rectum, and before the anus or the pelvic contents have been encroached upon. So slight is the pain, that in some instances patients consult a surgeon on account of some slight discharge from the anus or sense of uneasiness in the rectum, and an examination reveals the fact that a very extensive neoplasm is present, which must have existed for months previously.

It will be within the experience of most surgeons to have met with cases of malignant disease of the rectum, in which for months or even years trivial pain alone is complained of. Sooner or later, however, pain becomes a prominent symptom, and is frequently very intense. In no locality, not even excepting the tongue, is the suffering sometimes more severe.

* "Pathologie des Tumeurs," vol. ii. p. 281. Paris, 1867.



Fig. 856.—Sarcomatous Infiltration of Rectum, producing long tubular stricture. (Royal College of Surgeons, Ireland.)

The *pain* may be due to four distinct causes, and the character of the suffering in each case is quite distinct: 1. The disease may involve the anus, where, owing to the abundance of cutaneous nerves and continued motion of the part, the pain will be severe. 2. As the cancer extends beyond the limits of the intestinal tube, the nerves of the sacral plexus may be encroached upon, which may result in violent neuralgia, or in painful cramps of the muscles of the lower extremity. It is well to bear this always in mind, as not infrequently an attack of (so-called) "sciatica" has been the first indication of a cancerous rectum. 3. Obstruction, when situated in the rectum or lower part of the sigmoid flexure, is followed by a considerable amount of pain, which is always that of a paroxysmal character, and associated with frequent efforts to defæcate. 4. Implication of the bladder will be, of course, associated with considerable pain, especially if the disease has progressed so as to form a fistula, and permit the flow of fæces into the bladder, or of urine into the rectum.

Bleeding is a symptom which is seldom altogether absent; and on the other hand is not often severe. It commonly follows the passage of hardened fæces, and may be taken as an indication that ulceration has commenced. A certain amount of *discharge* is also a common feature, frequently blood-stained and abominably fetid. At a later stage this discharge, mixed with thin fæces, comes away through the patulous anus, the relaxed sphincters having lost all power of control. The skin about the neighbourhood becomes excoriated, constituting by no means the least of the miseries to be endured by the sufferer.

Diarrhœa may alternate with *constipation*, or be continuously present, and is often the earliest symptom which attracts attention. Every case of diarrhœa, or so-called dysentery, which has become at all chronic, should be examined by the rectum, and in not a few the cause will be found to be a malignant growth. I have many times seen cases which had been treated for diarrhœa for considerable periods which owed their origin to this cause, and the importance of making an early examination in these cases cannot be over-estimated. Early diagnosis is of more importance here probably than elsewhere, the great majority of cases not coming under the notice of the surgeon until the disease is so far advanced that the hope of successful operative interference is past.

Narrowing of the intestinal tube, sufficient to retard the passage of fæces, may be due to two distinct causes in cancer: either the neoplasm may by its exuberant growth obstruct the calibre of the bowel; or in the more chronic form the cicatricial contraction may form a true stricture of the gut. In either case the symptoms will be similar. Stricture of the rectum produces symptoms in some respects differing from those met with in obstruction of the intestine higher up. The continuous straining and tenesmus that are so marked in the former are absent in the latter, while vomiting of fæcal matter, which comes on tolerably soon when the small intestine is completely stenosed, may not appear for a very long time when

the rectum is occluded. In some of the recorded cases complete obstruction was continuous for many weeks or even months before continuous and fæcal vomiting supervened.

Cancerous obstruction, which may have existed for some time, may eventually give way, and an exit again be established for fæces through the rectum, or by an alternative route. In the first instance, the neoplasm may slough to such an extent that the bowel will become pervious again, or ulceration of the bowel above the obstruction may lead to perforation and the formation of stercoral abscess, which may open into the bowel below the cancer, thus affording a new, though not very efficient, route for the fæces.

Where an opening of sufficient size forms into the vagina, the more urgent symptoms of obstruction may be relieved, but the patient will be left in a truly miserable state; but where the opening takes place into the bladder, no sufficient exit for fæces will be by this means provided, and the urgency of the obstruction will continue; while at the same time the other symptoms will be much aggravated. Opening into some of the pelvic viscera by ulceration may be due to breaking down of the neoplasm itself, or it may be due to the distension and irritation of fæces above the obstruction; the ulceration then being of a simple character. This form of stercoral ulceration may take place at a long distance above the seat of obstruction, several cases being recorded where the cæcum has given way and produced a fatal peritonitis, in consequence of the dilatation due to rectal cancer. At other times nature has attempted to overcome the obstruction by the formation of an artificial anus at some part of the cutaneous surface, but such cases are of extreme rarity, and likely only to give a very inefficient relief to the obstructed gut.

When *secondary tumours* have formed in the liver there may be indication of its increase in size; and possibly, if the abdominal wall be thin, the surface may feel irregular and knobby.

Edema of either leg is a symptom not uncommonly present in the later stages, and is usually of grave import as indicating an involvement of the iliac vein in the disease. In common with all forms of cancer, the peculiar cachexia soon becomes obvious, and if hæmorrhage has been at all abundant, it comes on more rapidly. The onset of bladder implication is indicated by frequent and painful micturition, and fistula is, of course, soon rendered obvious after it has occurred.

The duration of symptoms may, in difficult cases, materially assist the diagnosis. If there is a history of rectal trouble slowly increasing for years, it is highly probable that the disease is not malignant.

Digital examination.—Whenever the symptoms of rectal cancer exist at all, a complete digital examination should be made. In the majority of cases, within a short distance of the anus the surgeon will feel a hard nodular and irregular surface, which may surround the entire circumference of the bowel, or be more particularly confined

to one side of it. When stricture exists, the tumour frequently is felt projecting into the lumen of the bowel, and conveying to the finger a sensation almost exactly resembling that of the os uteri. Should the finger not encounter anything abnormal, the patient should be made to stand up, and the digital examination should then be repeated, the patient at the same time being told to bear down. In this way a tumour which was not within reach by the ordinary method may occasionally be explored. Should nothing still be felt, and the symptoms clearly point to rectal disease, the patient should be etherised, and a careful bi-manual examination instituted, with the patient in the lithotomy position. This method is also of use in determining the height to which neoplasms that are easily recognisable below, extend upwards. The existence of malignant disease having been determined, it is essential, with a view to treatment, to determine the following points: First, the distance to which the disease extends upwards; this may be done with the finger alone, by the bi-manual method, or by a ball-ended probang. Secondly, the movability of the rectum upon the other pelvic structures; this is of use in estimating whether or not the disease has spread past the limits of the intestinal tube. And thirdly, a careful examination should be made to feel, if possible, any enlarged glands, which may sometimes be felt in the hollow of the sacrum through the rectal wall. In examining a case of this kind the greatest care should be employed, as in several recorded cases the attempt to pass a probang, or even a roughly made digital examination, has been followed by rupture into the peritoneal cavity.

In the female additional information may be gained by vaginal examination, the extent of the growth being sometimes easily determined through the recto-vaginal septum; while the fixity or freedom of the uterus is a point of great importance to make out.

Diagnosis of rectal cancer.—There are but two conditions with which rectal cancer is likely to be confounded, namely, tumours external to the intestinal tube and non-malignant stricture.

In the case of the former the diagnosis is easy if the disease is within reach of the finger. The fact that the mucous membrane is freely movable and that the neoplasm is unquestionably outside the bowel will render the matter clear. Uterine tumours, or even the fundus of a retroflexed uterus, by pressing on the rectum and causing obstruction, have given rise to an erroneous diagnosis of rectal cancer.

To distinguish between the malignant and non-malignant strictures is occasionally a matter of great difficulty. In this the duration of symptoms will prove of much service, the onset and progress of the non-malignant being extremely slow. The sensation conveyed to the finger will also be different. The ordinary stricture is smoother and more regular, and there is generally an absence of the nodular and protruding masses so characteristic of cancer. Cripps has also drawn attention to the fact that in the malignant form there is usually a portion of tolerably healthy mucous membrane between

the cancer and the anus, whereas in the non-malignant stricture this portion is generally more or less infiltrated.

The diagnosis between squamous epithelioma of the anus and papillomata is sufficiently easy, as in the latter the skin surrounding the tumour is not involved, the neoplasm being in some instances even pedunculated, whereas in the epithelioma there will be considerable infiltration of the true skin.

Treatment of rectal cancer.—The *medical treatment* of cancer of the rectum presents two chief points that must be borne in mind by the surgeon: first, to ensure that the bowels are kept sufficiently free to obviate the occurrence of fecal accumulation above the disease; and secondly, to supervise the use of morphia and other narcotics. In order to relieve pain, morphia, either hypodermically—in the form of suppositories—or internally, is frequently used somewhat recklessly, with the result that there is superadded to the miseries of the rectal cancer the mental suffering and total inability to bear physical pain, of the morphia habit, so that unless used with a very sparing hand, opium, instead of rendering the remainder of life more comfortable, will add to its suffering.

The use of bougies, or any dilating instrument, is attended with extreme danger, several cases of fatal rupture having been induced by this means.

The *operative treatment* of cancer of the rectum may, with advantage, be classed under two heads: the one necessarily palliative, as directed only to the relief of the prominent symptoms of intestinal obstruction and pain; the other having for its object the complete removal of the disease.

Of the former, three operations are at present practised where extirpation is inadmissible. Of these colotomy must still be ranked in the first place, and in cases where obstruction is a prominent symptom it should be certainly adopted; but in cases of advanced cancer of the rectum where excision is impossible, but where obstruction is not marked, I believe it is far better to treat the case on purely medical principles. The other palliative operative measures are linear proctotomy or vertical division of the constricted part—as a means of relieving the obstruction—and curetting away the cancerous infiltration. The cases in which it would be possible to perform linear proctotomy are so low down, that they could generally be treated by excision. Scraping with a curette appears to have given temporary relief in some cases, especially where hæmorrhage and purulent discharge were profuse.

Excision of the rectum is now a thoroughly established operation, and although at first it met with a great deal of opposition in England, it is now pretty generally adopted as the best treatment in selected cases.

In order to arrive at a just conclusion as to the advantages of extirpation of the rectum, it is necessary to review the course which rectal cancer runs when not subjected to operation. It would appear, from a consideration of a large number of statistics, that the

average duration of life is about two years from the appearance of the first symptoms, and during that time the condition of the patient is truly miserable. Where obstruction is present, the constant straining is a source of perpetual pain and annoyance to the patient, and even when this symptom is not present the continued mucous and bloody discharge, the extreme pain suffered when the disease encroaches on the bladder, the anus, or the nerves of the sacral plexus, combine to render this disease one of the most distressing that can possibly come under the observation of the surgeon; and it is little to be wondered at that any operation which can hold out a chance of remedying this condition should readily be grasped at by both surgeon and patient. We must, however, consider the question from more than one point of view: first, as to the immediate risk to life; second, as to the probability of complete cure, and, if so, the condition in which the patient will be left; and, lastly, supposing recurrence to take place, how long will it be delayed, and what will be the course of the secondary disease. I am convinced that a careful and unbiassed consideration of the facts bearing on these questions will serve to convince the impartial observer that they are not only sufficient to justify the operation in suitable cases, but that it is the duty of the surgeon strongly to recommend it.

In many respects the history of rectal extirpation resembles the early history of ovariectomy, and it is highly probable that with increased care in wound treatment and operative detail, the rate of mortality will be materially lessened. It is, therefore, at present premature to be guided too much by statistics. As it is impossible completely to obviate stercoral fouling of the wound, sepsis is still a frequent cause of death after these operations. At present the rate of mortality amongst the best operators is probably not less than 15 per cent.

Although the total number of cases is as yet small, and the opportunity of judging whether many of the apparent cures will be permanent is insufficient, the results hitherto recorded will compare most favourably with the records of operation for cancer in other parts of the body, notably the tongue and breast, both as regards the prolongation of life, and the possibility of complete cure.

As to the condition of the patient after recovery from operation, we must remember the horrible disease for which that operation was performed, and compare the condition before and after its removal. When the sphincter has not been removed, the amount of incontinence is usually trivial, and it is only when there is diarrhoea that any trouble arises. This is generally easily met by the use of an antiseptic pad. When the entire lower end of the rectum has been removed a considerable amount of control often is maintained, but even in the worst cases of incontinence met with after ablation of the rectum, the result compares favourably with the usual artificial anus following colotomy, and is vastly preferable to the state of a patient suffering from advanced rectal cancer.

A more troublesome sequela of operation, than incontinence, is

stricture, which in many of the recorded cases appears to have given a very great deal of trouble. In those cases where it has been found impossible to draw down the gut and suture it to the skin, the extensive surface heals by granulation, and the orifice gradually becomes constricted; even in the hands of some of the most skilful surgeons, treatment by means of tubes, incision, or even colotomy has been subsequently required. If, however, a small strip of mucous membrane can be retained down to the anus, or the mucous membrane brought down and sutured to the skin, this trouble is not likely to arise. The freedom from incontinence which some of these patients enjoy is very remarkable. In a case of my own there is a slight prolapse of mucous membrane which occludes the anus, and prevents escape of fæces, except during defecation.

Recurrence of the disease usually takes place as nodular masses in the cicatrix, or in the deep lumbar glands, liver, or other internal organs. When occurring in the cicatrix, a secondary operation is often attended with good results. And even where not suitable for removal, these secondary growths are usually much less painful than the primary disease, owing to the destruction of the sensory nerves of the region at the time of operation. Death from internal cancer is also considerably less painful than that from unchecked cancer of the rectum.

The operation.—The following description of the operation of perineal excision includes the principal points to be borne in mind. In order to prepare a patient for operation, a dose of purgative medicine should be given for a couple of nights before, and the bowel well emptied by a copious enema on the morning of the operation. The patient should be retained in the lithotomy position by means of Clover's crutch, and an incision carried deeply from the back of the anus to the coccyx.

If the entire circumference of the bowel, including the anus, is diseased, incisions should be now carried well clear of the disease round the anus, and deeply into the ischio-rectal fossa, the attachments of the levatores ani divided, and the dissection carried upwards posteriorly and at the sides. This can be readily accomplished, but in front there is always considerable difficulty owing to the close attachments of the rectum to the bladder and urethra in the male, and the vagina and uterus in the female. In the former the presence of a full-sized sound in the urethra will prove of much assistance, and in the latter the occasional introduction of the finger into the vagina will serve a like purpose. For dissecting the intestine free, a pair of blunt-pointed scissors will be found the most convenient instrument; and assistance may be gained by the use of a blunt hook, using it in the same way that a strabismus hook is used to hook up the ocular muscles in an enucleation of the eyeball. If the disease has not implicated the anus, or if a vertical strip of mucous membrane be unaffected, the preceding operation should be so far modified as to leave as much normal tissue as possible, care being always taken that at least one quarter of an inch of healthy

tissue surrounds the disease upon all sides. The dissection having been carried up to healthy tissue above the disease, the rectum is to be amputated. For fear of hæmorrhage this has frequently been done with the *écraseur*, the Paquelin cautery, or even the ligature; but as the part is so well under control bleeding need not be feared, and the section can be made much more cleanly with a pair of curved scissors. A number of catch forceps should be at hand to secure vessels as they are divided, but there is not likely to be any free bleeding until the last section is made, and then the arteries can be picked up and tied, generally without difficulty.

The rectum should now, if possible, be brought down and

accurately sutured to the skin. Much of the success of the operation depends on the way in which this is done. If the sutures are simply passed through skin and bowel, they will soon cut out (B and D, Fig. 857), and what is far more serious, they tend to form cavities in the wound, in which fluids may collect and become septic. If, however, four deep sutures are passed under the entire divided pelvic structures (A and C, Fig. 857), the gut is firmly held and wound cavities are obliterated, a few superficial sutures being sufficient to complete the union.

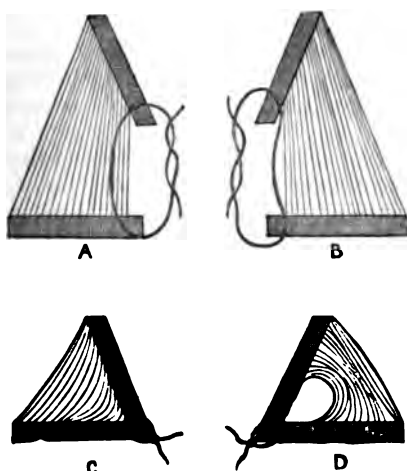


Fig. 857.—Diagram showing the Method of passing Sutures.

A, Suture passed deeply; C, the same suture closed; B, suture passed through bowel and skin only; D, the same suture closed.

After the operation an attempt may be made to keep back the fæces by plugging the gut with iodoform gauze or other similar antiseptic material, a catheter passed through the plug being left in the bowel to permit of the escape of flatus. If the gut will tolerate this plug, and it can be left *in situ* for a week or ten days, it will prove of enormous advantage, by permitting a complete adhesion of the gut to the perineal wound to take place. The diet for the first fortnight after the operation should be carefully regulated, so as to leave as little solid residue as possible.

Complications of the operation.—Wound of the peritoneum is of frequent occurrence. When, however, the rent is carefully sutured up, the risk is apparently not increased.

Implication of the other pelvic structures is a very serious complication; and, when extensive, must be held to contra-indicate operation. A slight involvement of the recto-vaginal septum

however, can easily be dealt with, the vaginal opening being either closed at the time of operation, or by a subsequent plastic procedure. Where, however, the bladder, prostate gland, and urethra are much involved, the prospect of useful interference is small indeed.

Amongst the *modifications of excision*, the combination of colotomy with it is one of the most important. M. Maurice Pollosson* advocates the combination of laparo-colotomy with extirpation of rectal cancer.

After the patient has recovered from this operation, he proposes to extirpate the cancerous mass, which, by virtue of the preliminary operation, is practically removed from its relations as a part of the digestive tract, and converted into a pelvic tumour. Operating under the conditions so brought about, it is possible to apply the principles of antiseptic surgery much more thoroughly and more efficiently than in the conditions existing without such a preliminary operation.

The removal of cancers situated high up.—Dr. P. Kraske of Freiburg † communicated to the German Surgical Congress a method which he had worked out on the cadaver. According to him, access to the upper part of the rectum is made far easier by splitting the soft parts in the middle line from the second sacral vertebra to the anus, dividing the muscular attachments to the sacrum as far as the ends of the bone on the left side; excising the coccyx, and then dividing from the sacrum the attachments of the two sacro-sciatic ligaments, and drawing aside the left edge of the wound. Still further access to the upper portion of the rectum is gained by chiselling away a bit of the lower left side of the sacrum. If the bone be divided in a line beginning on the left edge at the level of the third posterior sacral foramen, and running in a curve concave to the left through the lower border of the third posterior sacral foramen, and through the fourth to the left lower corner of the sacrum, the more important parts, especially nerves, are not injured; and the sacral canal is not opened. The upper portions of the rectum thus become so accessible that the rectum can be brought into full view and amputated without difficulty up to where it passes into the sigmoid flexure.

Kraske's paper has opened up a field of operation in cases that before were considered quite inoperable, and his method has now been frequently adopted and modified in several important details, particularly by the German surgeons. The method adopted by Bardenheuer appears at once the simplest and most satisfactory. An incision is carried from the back of the anus to the middle of the sacrum; the muscles are divided from the sacrum and the sacro-sciatic ligaments cut through; the sacrum is now cut through transversely at the level of the third sacral foramen; the divided bone is removed; and the posterior surface of the rectum is cleared in the superior pelvi-rectal space (above the levatores ani with their fascial coverings). As the whole hand can now be introduced into the pelvis

* *St. Louis Courier of Medicine*, July, 1884.

† "*Annals of Surgery*," vol. ii. p. 415; 1885.

the bowel can be explored up to the sigmoid flexure if necessary. If the disease is situated entirely above the attachment of the levatores ani, the resection of the diseased bowel with circular suture of the intestine can be effected; or where the anus is involved this portion can be extirpated and the upper lumen of the bowel brought down and sutured to the most convenient portion of the incision.

I have adopted the trans-sacral extirpation of rectal cancer in six cases, in all of which a successful result was obtained.

The performance of circular rectorraphy, by means of which the sigmoid flexure is united to the anal portion of the rectum without injury to the floor of the pelvis or to the sphincters, is an ideally perfect operation; but hitherto the success attending this procedure has not been large, apparently due to the fact that in the first attempts at defæcation after operation, portion of the freshly united intestine is apt to give way in the effort to dilate the anal canal; in this respect circular rectorraphy contrasts unfavourably with the similar operations on the small intestine and colon, where no such strain has to be encountered. This difficulty may be met in one of two ways; the incision may be carried through the sphincters into the anus, and the wound thus formed kept open until union of the intestine above is firm, when it can be closed by a plastic procedure; or, what I should prefer, and intend for the future adopting, is to suture carefully the front and sides of the rectum, but to leave in the first instance a sufficient opening for defæcation posteriorly; if then the fistula thus formed did not close by granulation, it could readily be occluded by a plastic operation, when the rest of the circumference was firmly united.

In one of my cases in which union was good in front and at the sides, a fæcal fistula formed posteriorly, which gradually spontaneously closed, leaving the continuity of the intestinal tract perfect.

Pruritus ani, or, as it has been not inaptly termed, painful itching of the anus, is a most distressing complaint when met with in an aggravated form; patients frequently stating that it is much more difficult to bear than acute pain, and that their lives are rendered absolutely miserable by it. As it may arise from a multiplicity of causes, it may tax considerably the powers of the surgeon to cure. It will, therefore, assist in the consideration of the subject if we discuss in detail the various diseases of which pruritus ani is a symptom.

Eczema, as one of the not unfrequent causes of pruritus ani, occurring in the neighbourhood of the anus, may be of two forms, viz. the moist, and the dry. In the first, the skin surrounding the anus is red, and exudes a rather copious gummy discharge. When severe, there may be some subcutaneous edema, and it is attended with smarting pain, in addition to the severe itching. This form demands *treatment* by soothing applications, such as the linimentum calcis, unguentum zinci, etc.; or, in some cases, it will be found more comfortable to apply boric acid in fine powder dry, which, mixing

with the discharge, forms an antiseptic crust, protecting the raw and sensitive surface. In the dry form of eczema the skin round the anal margin is dry and cracked; the surface is covered with dry scales, which, if removed, disclose a red and sensitive surface. This is the form met with in connection with the lithic acid diathesis, and the itching produced by it is very severe. It must, however, be distinguished from a somewhat similar appearance produced by scratching to relieve pruritus arising from other causes. This form of eczema requires an essentially different plan of treatment. Here some of the tar preparations will be found more suitable, such as the compound soap liniment, which consists of equal parts of soft soap, oil of cade, and rectified spirit; or the part may be bathed with a solution of simple tar water.

The possible presence of **parasites**, pediculi and scabies, as a cause must be remembered, while oxyurides in the rectum frequently produce pruritus.

A certain number of cases, mostly very inveterate ones, remain, in explanation of which it is impossible to find any local cause, and which must be, in the want of accurate pathological knowledge, described as **neuroses of the rectum**. Usually found in elderly men, but not by any means confined to the male sex, they appear to attack the plethoric and the spare, the rich and the poor alike. The patient is not much disturbed during the day, but when he goes to bed his misery begins. The itching is so intense that it is impossible to avoid scratching, which, instead of giving relief, only adds to the trouble. Sleep at first is impossible, but when at last it comes it is frequently but of short duration, the patient being awakened by the intolerable itching. If an examination be made, the skin around the anus will usually be found devoid of its normal elasticity, and parchment-like. Immediately in the neighbourhood of the anus the normal pigmentation will be absent in patches, the skin here being of a dead white.

Treatment.—This condition is one extremely difficult to cure. What relieves one case is no use to another. Cocaine hydrochlorate (4 per cent. solution) sometimes gives relief, or an ointment of oleate of mercury and morphia may be tried. Bathing with very hot water or solution of carbonate of soda, chloroform ointment, painting with solution of nitrate of silver, have all been found useful in isolated cases.

L. DISEASES OF THE BREAST.

By W. WATSON CHEYNE, F.R.S., F.R.C.S.

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Deformities of the breast.—The deformities of the breast may be divided into congenital and acquired.

The **congenital anomalies** consist either in imperfect formation of the mammae or in the existence of supernumerary mammae. An excessive number of mammae is not such an uncommon deformity as one might at first suppose. According to Dr. Mitchell Bruce, of nearly 400 patients, men and women, examined consecutively, sixty-one had supernumerary nipples, and of these, curiously enough, forty-seven were males and fourteen females. This congenital deformity may assume three forms: (1) an additional nipple or nipples without a breast; or (2) a breast without a nipple; or (3) a more or less complete additional organ. As a rule, the accessory breasts are rudimentary, and it is more frequent to meet with an accessory nipple without a breast than with any of the other forms. Only very few cases have been met with where a complete additional mamma was present, but in a certain number such has been the case, and the organ has secreted normal milk. These supernumerary mammae are generally situated on the anterior part of the trunk, and are said to occur most commonly in the lines of the internal mammary, or of the deep epigastric arteries. They have, however, been found in the groins, and even in the lumbar region. They seldom give rise to any inconvenience, and are very often not recognised by the patient. Where, however, they cause annoyance from secretion of milk during lactation, there is no objection to their removal.

Absence of one or both mammae is an extremely rare occurrence and apparently is only met with in monstrosities.

The most frequent deformities in the way of imperfect formation of the mammae are malformations of the nipple interfering with lactation, the malformation consisting essentially in its being too short. In some cases, however, the nipple lies at the bottom of a recess—so-called umbilication of the nipple—and while it itself is well formed, its position renders it useless for lactation. This condition may be remedied by taking out a crescentic piece of skin on

each side at the margin of the fossa in which the nipple lies, the piece removed being of such a breadth that, when the wound is stitched up, the base of the nipple is drawn out on a level with the rest of the breast.

The **acquired anomalies** of the breast are also uncommon. Hypertrophy of the breast is a very rare occurrence, and in all probability the great majority of cases which are spoken of as hypertrophied mammae are really cases of diffuse adeno-fibroma in the gland. In proof of this, it is generally found that these enlarged organs, during pregnancy and lactation, either do not secrete milk at all, or, at any rate, not to the same extent as the other breast; whereas, were it a true hypertrophy of the gland, we should expect the converse condition. Where the enlargement is such as to cause deformity and inconvenience, excision of the breast is the only satisfactory treatment. Atrophy of the breast occurs naturally in old age, after the menopause, but it is also, in very rare cases, found in young women, and in these instances it is probably most often the result of an attack of mastitis during infancy or childhood, or is associated with imperfect development of the genital organs, etc.

Acute inflammation of the breast.—The inflammatory affections of the breast are of the greatest importance, both as regards the effect on the secreting power of the organ and its functional activity, and also as regards its relation to other diseases. The simple inflammatory affections of the breast may be either acute or chronic. Among the acute inflammations, we have to describe not only acute inflammations of the gland tissue itself, but also cases where the inflammation is situated around the gland, either between the gland and the skin, or beneath it; we have, further, to consider inflammations of the nipple and areola.

Inflammation of the nipple.—Of the inflammatory troubles affecting the nipple and areola, we may mention first cracks and fissures, or what are commonly known as “chapped” nipples. This condition rarely occurs, except during lactation. The predisposing causes are delicacy of the skin and malformation of the nipple, necessitating increased effort on the part of the child. A most important cause, also, is imperfect attention to the nipples, more especially to cleanliness and dryness. Chapped nipples are produced mainly by the maceration of the epithelium by the saliva or the milk, leading to denudation of the Malpighian layer of the skin, this being aided by the sucking action of the child; and the surfaces so denuded are liable to become infected, especially where the infant suffers from the condition of aphthous mouth. These fissures are generally multiple and radiate from the centre of the nipple. They are situated on the nipple or on the areola, most usually on both.

Symptoms.—Their presence gives rise to intense pain, the slightest touch or attempt on the part of the child to suck setting up a paroxysm of pain very much the same as that caused by fissure of the anus. Further, these fissures are very apt to become inflamed,

as the result of septic infection; they also bleed very readily, and if suckling is persisted in the child may swallow a quantity of blood, which will give rise to sickness and interfere with nutrition. Even worse than the swallowing of blood is the swallowing of pus in cases where the fissure has developed into a regular ulcer secreting pus, for in such circumstances the child may actually become infected with some septic disease.

Treatment.—As regards the treatment of this condition, in the first place the patient must take all precautions to avoid its occurrence. If the skin be tender or the nipple deformed, the patient should not suckle the child too often; and, after suckling, the breast should be washed with boric lotion, thoroughly dried, and then dusted with a little boric powder, which should, of course, be wiped away the next time the child is placed at the breast. When fissures are actually present, it is, in most cases, best for the patient to give up suckling with that breast; but if the mother will not do so, the next best thing is to employ one of the various shields which fit over the nipple, and through which the child may suck without causing the same amount of pain, or running so much risk as when it sucks directly from the nipple itself. In such cases, in the intervals between suckling the fissures must be treated with antiseptic lotions, such as that of boric acid, boroglyceride, etc., or lotions of sulphate of zinc, sulphate of copper, and even nitrate of silver if the lesions are not healing. The pain may also be relieved by cocaine ointment. If, however, the ulcers are obstinate, the surgeon must insist on the patient giving up suckling with that breast.

As I have already mentioned, these fissures are very apt to become infected with septic material, with the result that erysipelas, lymphangitis, subcutaneous abscesses, etc., occur. This is usually due to some septic condition of the mouth of the child, or the presence of purulent ophthalmia, or want of cleanliness on the part of the patient, etc. The result of the infection is that the crack becomes more tender, red lines are seen spreading from it towards the axilla, and the axillary glands become enlarged. Not uncommonly small abscesses form along the course of the lymphatic vessels, more especially under the areola. At the same time, the patient generally has shivering, feels ill, the temperature is raised, and the pulse becomes more rapid; in fact, all the ordinary symptoms of lymphangitis are developed. As a rule, however, unless some special septic organism has entered—such as that of erysipelas—the condition is not a grave one and ends either in resolution or in the formation of a subcutaneous abscess. The treatment is that which has been already discussed in the early part of this work in speaking of inflammation, lymphangitis, etc. (pp. 66, 665, Vol. I.).

Inflammation of the gland.—*Acute inflammation of the gland* itself may follow injury, and most usually occurs during pregnancy and lactation, especially the latter. It occasionally, however, appears soon after birth and at puberty. Usually the

breasts swell for two or three days after birth, and secrete a small quantity of milky fluid, and this condition may last for several days. If the breast be injured or squeezed—as is very commonly done by ignorant midwives—this congestive condition of the gland may pass into true inflammation, the skin over some part of the organ becoming red and tense, and one or more hard masses may form, which suppurate and ultimately burst. The real gravity of this condition is not so much in the first effect as in the fact that when the inflammation is diffuse the development of the organ may be subsequently interfered with. In other cases suppuration does not occur, but as the result of the organisation of the inflammatory material retraction of the nipple takes place. At puberty also the inflammation which occurs is most often non-suppurative, in the form of lobular mastitis, and affecting one breast only.

In the majority of cases abscess in the gland occurs during lactation and is most frequent in primiparæ.

Sources of infection.—There are three conceivable sources of origin of the pyogenic organisms—namely, by the blood stream, or by the lymph stream, or by spreading up the milk ducts, and the last is by far the most common mode. As regards the lymphatic origin, the lymphatics which lead from cracks of the nipple and so forth run superficially to the organ and directly to the axillary glands, and it would only be rarely (and mostly when the lymph flow is blocked) that organisms would pass back by the lymphatics into the gland. As regards the entrance from the blood, this may occur in septicæmic conditions, the organisms passing out of the blood-vessels around the acini, and setting up inflammation there. As a rule, such a mode of origin only takes place in very grave septic disease, and leads to a more or less diffuse suppuration of the organ. The ordinary circumscribed abscesses of the breast occurring during lactation, apparently most commonly arise by the spread of the organisms up the milk ducts. Certainly this seems to be the fact, according to Bumm's researches, when the suppuration is due to staphylococci; where streptococci are the active agents, they may spread by the lymphatics. As has now been definitely shown by a variety of investigations, as a rule preceding the formation of the abscess in the gland there is a history of ulceration about the nipples. The organisms, in the first instance, develop in the ulcer, then spread up the milk ducts till they reach one or more acini. They there cause coagulation of the milk and penetrate through the walls into the tissues around. Suppuration occurs, the foci in the neighbouring acini unite, and form a general abscess, this abscess being consequently irregular in form and having diverticula running among various lobules of the gland.

Symptoms of acute abscess.—When the abscess has once formed, the pus spreads either to the skin, or to the submammary tissues, leading to the formation of a submammary abscess, or in both directions at the same time. As a rule, these abscesses occur soon after delivery, and it is not always easy to distinguish between

the general engorgement of the breast which is present at that time and the actual commencement of this acute inflammation. Usually, however, at the commencement of the inflammation there is shivering, followed by fever and a feeling of weight and pain in the breast. This pain soon becomes extremely acute, so that the slightest touch or movement causes intense agony. In the early stage the swelling is limited to one part of the breast, but the skin is not red over it, and the axillary glands are not at first enlarged. On palpation at this stage one feels a diffuse resistance at one part of the gland, which is intensely painful and tender; but at that part there is not yet any adhesion to the skin, and the gland moves freely over the deeper parts. In the early stage, also, gentle but continued pressure on the swelling may cause pus to exude from the nipple, this pus being distinguished from the milk by its viscosity and yellowish colour. As time goes on fluctuation becomes evident, and, as in other acute abscesses, the inflammation gradually approaches the skin, which becomes red, and ultimately the abscess points and bursts through it. In the early stage the condition may resolve, all the pus escaping by the milk ducts; but this is a very uncommon occurrence, and as a rule the further history of the case is as I have mentioned—that the original abscess tends to point and burst through the skin, while at the same time fresh foci of suppuration are apt to form in the vicinity, these foci ultimately uniting with the original abscess and leading to the formation of an extremely irregular cavity. If nothing be done, the condition goes on, fresh sinuses form, the suppuration extends over other parts of the gland, and ultimately the organ may be completely destroyed.

As a rule, there is but little difficulty in diagnosing the condition, the presence of fever and the intense tenderness localised to one part of the breast sufficiently distinguishing it from the physiological engorgement of the organ, while the absence of redness of the skin and of red lines, and of early enlargement of the axillary glands, excludes the ordinary lymphangitis and superficial inflammation spreading from cracks on the nipple. Further evidence is afforded by the presence of nodules in the gland itself and by the escape of pus from the nipple.

- Treatment of acute abscess.*—As regards the treatment, the prophylactic treatment is very important, and consists in strict attention to cleanliness, the use of antiseptic washes—such as boric lotion—
- after each suckling, careful attention to cleanliness of the linen, to the condition of the mouth and eyes of the infant, and more especially the employment of great care where excoriations or cracks exist.
- Where the inflammation has actually occurred, but where it is not yet evident that suppuration has taken place, the breast should be fixed and supported by means of a bandage, and should be very gently pressed from time to time, so as, if possible, to squeeze out any pus which may have collected in the acini or tubes. The arm should also be fixed to the side, as is done after excision of the breast, and nursing should be discontinued with both breasts.

As soon as it is evident, from the œdema and redness of the skin, or from the duration of the inflammation, or from the presence of fluctuation, that pus has formed, the abscess should be opened freely and antiseptically, in order to avoid the spread of the disease and the further destruction of the breast tissue. In opening the abscess it is of great importance that all the recesses should be thoroughly evacuated and drained, and it is in the great majority of instances necessary, on account of the great tenderness, to place the patient under an anæsthetic. Free incision is then made into the centre of the brawny swelling, and the finger is introduced, with a view of breaking down all the septa in the abscess cavity, so that the discharge may escape freely in all directions. A large drainage-tube should be introduced and strict antiseptic measures employed. If an incision is merely made in the skin at a part where the abscess is pointing, without opening up the various recesses of the cavity, fresh sinuses will almost certainly form and a very troublesome and serious condition arise; and this is also the case if poultices or other septic applications are employed as dressings.

Where the patient comes at a later period with a number of fistulæ in the breast, there may be a very great deal of trouble in getting them to heal, and it is essential, in order to save the breast, that all these sinuses should be thoroughly opened up, the finger being introduced so as to bring about free communication between the various sinuses and free opening of the various recesses. Drainage-tubes should then be passed in all directions through and through the different sinuses. If that be done it will be found that in a very few days the discharge ceases, and the drainage-tubes may be shortened and ultimately withdrawn. As I have already mentioned in speaking of the treatment of wounds, I have the greatest objection to washing out these sinuses with antiseptic fluids, this being, in my opinion, an unnecessary and disadvantageous process (p. 225, Vol. I.). In some instances the destruction of the breast is so complete that excision may be the best treatment.

Submammary abscess.—In certain cases these acute abscesses form in deeply-seated lobules of the breast, and, instead of spreading towards the surface in the first instance, extend into the loose cellular tissue beneath the gland and give rise to an acute submammary abscess. This is by far the most common mode of origin of these submammary abscesses, but they are said to occur occasionally after injuries, leading to hæmatoma beneath the gland, which undergoes suppuration. Where we have the condition of acute submammary abscess, the breast is raised *en masse* and projected forwards without there being any alteration in shape in the way of the formation of nodules at one or other part of the gland; the various symptoms of acute inflammation are present and the skin over the breast is hot, but not red. Very soon, however, œdema of the tissues around the base of the mamma occurs, and when this is found it may be reckoned almost to a certainty that suppuration has already taken place. Fluctuation is not at all easily made out so long as the pus

is confined behind the breast. The best way of examining fluctuation is to place the fingers of one hand at the margin of the organ, more especially the outer and lower part, and then sharply press back the gland as a whole.

The treatment consists in early evacuation of the pus by incision at the lower and outer part of the gland where it usually points, and by thorough drainage of the cavity.

Chronic inflammation of the breast.—Chronic mastitis may be described under two forms: in the one the inflammation is limited to one segment of the breast, and the inflammatory swelling forms a tumour of considerable size (*chronic mastitis*); in the other the inflammation attacks numerous lobules of the breast, so that the organ acquires a granular feel, from the thickening of the individual lobules—the condition known as *chronic lobular mastitis*. With this latter affection will also be considered *multiple cystic disease of the breast*.

Chronic mastitis. Causes.—The majority of cases of chronic mastitis follow lactation or injury, though in some cases the condition may appear without any definite cause. In connection with lactation the disease occurs most frequently at the period of weaning. As regards injury, it may result from one severe injury, which probably acts by leading to a localised hæmorrhage, which may not become properly absorbed, and may set up inflammation; but more commonly it is the result of repeated slight injuries, more especially where the mammae are large or heavy, such injuries as playing the mandoline, where the end of the instrument rests on the breast, pressure from the corsets, etc.

Symptoms.—As a rule, a patient in the first instance notices vague pains in the breast, and on examining it finds that there is a nodule or a patch of thickening which is somewhat sensitive. The pain is variable, but is usually comparatively slight. The swelling generally enlarges slowly, so long at any rate as the original cause, such as repeated pressure, is in action. Its outlines are quite diffuse, it is generally somewhat firm and elastic, and tender in some cases. When suppuration is about to occur, the tenderness is acute. The swelling moves with the rest of the breast, and for some time the skin remains unaffected. The axillary glands may or may not be enlarged, but if they are enlarged, they are generally numerous, and their size is usually greater than that of cancerous glands, while they are met with at an earlier period in the disease than the latter. Where suppuration is occurring, the skin becomes more adherent and fluctuation becomes evident. This often does not occur for two or three months from the commencement of the disease. In some cases the milk-ducts become involved in the inflammatory growth and the nipple may be somewhat retracted.

Diagnosis.—The diagnosis of this condition is often very difficult, the disease with which it is most likely to be confounded being the ordinary cancer of the breast. They resemble each other in that the tumours are usually badly limited; but at a comparatively early period in a cancer the skin becomes pulled on so that a dimple may be

formed, and the skin puckers on attempting to push it over the cancer. In the case of the inflammatory swelling, this dimple does not form, in fact the skin is rather projected ; but where the skin is becoming adherent, the same sort of wrinkling may occur as in the malignant disease. The swelling in chronic mastitis is less circumscribed and less easily outlined than in carcinoma, and on pressing the mamma back against the chest wall the induration becomes less distinct than in the latter.

The ætiology is also a point of some importance, though it cannot be always relied upon ; but where in a young person a diffuse tender swelling with these characters is formed as the result of continued pressure, the probability is that we have to do with a chronic mastitis. The inflammatory condition also usually attains a larger size than a cancerous tumour, and at a comparatively early period of its existence ; and it is distinctly more tender, but not of such stony hardness as the cancer. Then again, this affection, as I have said, most frequently commences towards the end of lactation, whereas cancerous tumours rarely commence at that time, although, if they are already present, they generally grow rapidly. Then again, as regards glands in the axilla, these are sometimes enlarged in chronic mastitis, but if so, this enlargement occurs earlier, and the glands are larger and more numerous than is usually the case in cancer. Further, the pain in the case of chronic mastitis is chiefly on pressure, or on allowing the breast to hang down where it is heavy ; whereas in the cancer pain is often an early symptom, occurs spontaneously, and is of a neuralgic character ; tenderness is greatest in mastitis. Lastly, a rapidly-growing cancer, which is the form that would be confounded with chronic mastitis, causes rapid cachexia.

Treatment.—As regards the treatment of this condition, in the first place the breast should be supported, and any causes of irritation, such as pressure or friction, should be avoided. Anodynes may be applied to the part, but, as a rule, the best treatment is a succession of poultices. This will in some cases, if it does not disperse the swelling, hasten the occurrence of suppuration, and so clear up the diagnosis. If suppuration has taken place, the abscess should be freely opened in the way that has been already described. Where there is the least doubt as to the nature of a swelling, and where there is any possibility that there may be cancerous disease, the best treatment is at once to cut into it, and, if necessary, remove a portion of it for examination. Should it be a cancer, the diagnosis can almost always be made at once on examining the cut surface ; if it is an inflammatory swelling, free incision into it is by far the best method of treatment. Where the mass is small and not involving the centre of the breast, the quickest and best way of treating it is to cut it out.

Chronic lobular mastitis.—In this form there are numerous nodules in the breast, none of which attain any considerable size, and this condition does not lead to suppuration. Chronic lobular mastitis occurs at all ages, and is not definitely related either to lactation or to

injury; indeed, nothing is known as to the real cause of the disease. It is perhaps most frequent in women who have not borne children, and who are approaching fifty; but it also occurs about the age of puberty. As regards the size of the nodules, there seems to be a distinct relation to menstruation. This condition of chronic lobular mastitis is usually bilateral, but it may be more advanced in one breast than the other.

Symptoms.—The commencement of the disease is often quite insidious, and not uncommonly the presence of the nodules is discovered by accident. In other cases, however, there is a considerable amount of pain associated with the disease, and also some swelling of the breast. There is no general constitutional disturbance and no fever. When a patient is first seen, the condition is generally pretty well established. The mamma is usually somewhat enlarged, and on grasping the breast as a whole, it is found to be pretty firm, having lost the soft elastic character of the normal breast. If, instead of grasping the breast, it is pressed against the thorax, it is felt to be granular, numerous small nodules being scattered throughout its substance. These nodules are firm, rounded, and irregular, and their outlines are not generally very well defined. They seldom attain any considerable size, varying from a pea to a small hazel nut, and as a rule they are not particularly tender. The axillary glands are very seldom found enlarged, but they occasionally increase in size during the menstrual period. If left to itself, the disease may remain in *statu quo*, and though in some rare cases it may improve, the condition usually persists for an indefinite time. As a rule, also, the nodules are more perceptible during the period of menstruation, and fresh nodules sometimes appear in other parts of the breast at that time, and may disappear when the period ceases.

Diagnosis.—The diagnosis of this condition may be difficult. Where there are numerous small nodules having an oscillating course and exacerbations at the menstrual period, the diagnosis is pretty certain. The chief difficulty is in determining whether the diffuse cystic change of the breast has set in. In that case, however, some of the cysts generally attain a much larger size than is the case in mastitis, and the nodules vary very considerably in size. At the same time, we do not have the same oscillating course, while, as a rule, in chronic lobular mastitis there is little or no pain, and very little tenderness on pressure. In some instances the condition of *mastodynia* is present. In this case the symptoms are neuralgic pains, beginning in the breast, and radiating towards the neck, shoulders, back, etc., generally coming in crises, which may be very severe, and are generally worse before the menstrual period. These crises of pain come on without any apparent cause, or after some very trivial one, and they may lead to the patient losing sleep and health. This condition of *mastodynia* is often associated with ovarian irritation, but in the majority of cases a lobular mastitis will be found. *Mastodynia* is very obstinate, and will not get well if left to itself.

Treatment.—As regards the treatment of lobular mastitis, there

is comparatively little to be done. As a rule, it is sufficient to protect the breast from injury, and to employ compression, with strapping or a firmly applied bandage over a mass of cotton wool. Where there is pain, the use of belladonna plaster or other anodyne may be indicated. Where the condition of mastodynia is present, the compression cannot be borne for any length of time. The continuous current has been employed in some cases with benefit, and the condition of the genital organs should be investigated and treated, if necessary. Where the pain commences in relation with the enlarged lobules, it may be justifiable to amputate the breast; but after this operation—even where a distinct lobular condition has been present—it is not uncommon for the neuralgic pain to continue about the shoulders or neck, or to appear in the opposite mamma.

Multiple cystic disease of the breast.—This condition of chronic lobular mastitis usually ends in the multiple cystic disease of the breast. In some cases, also, it seems to pass into that of fibro-adenoma. On examining a lobule which is the seat of mastitis, the chief change in the early period is seen in the interacinous connective tissue, which has undergone marked proliferation, and is decidedly vascular. This may lead in parts to atrophy of the epithelium, but the usual secondary change is proliferation of the epithelium in the acini, which become enlarged and form microscopic cysts, and this change is often diffuse over the whole breast. While the great majority of these cysts remain quite small, one or two may enlarge and attain a considerable size. The epithelial changes do not apparently go on to cancer, although French writers especially seem to think that there is a distinct tendency in that direction.

Treatment.—This condition is usually bilateral, and generally extends over the whole gland. As I have already said, these cysts vary in size, and, as a rule, the patient consults the surgeon on account of the presence of a distinct small tumour, and it is only on examining the breast that one finds numerous small nodules in other parts. The contents of the cyst are yellowish clear fluid, or viscid muddy material. They form apparently by dilatation and fusion of acini, and, as I have just pointed out, most authorities consider them to be the result of a chronic mastitis. As a rule they do not cause any inconvenience, except the alarm occasioned to the patient by the presence of the tumours, and as a rule, also, they are not followed by malignant disease.

The question of treatment is a difficult matter. Some, who look on this condition as a sort of non-malignant epitheliomatous disease, advise the immediate excision of the affected breast, but such treatment seems to be unnecessarily severe, especially where the condition is bilateral, in which case the probability of malignancy is very much less. I think that in most cases the best course to follow is to tap and inject any cysts which are large enough for the purpose, and to leave the others for further treatment should they also enlarge. If however, there is any doubt about the nature of the case or the malignant tendency of the disease, the opportunity may be taken to

excise the larger cysts and examine the condition of the organ microscopically.

Tuberculosis of the breast.—Tuberculosis of the breast is not nearly so uncommon as has been supposed, and a considerable number of cases of chronic mastitis—especially those ending in suppuration—are in reality of a tuberculous nature. The tuberculous deposit most usually commences in a lobule around the acini, or actually in the acinus itself, and where the disease is advanced the acini generally disappear, and nothing is found to represent the lobule but a tuberculous mass. As a rule, tuberculous trouble tends to spread along the lymphatic paths, and one seldom finds the disease limited to one individual lobule. Fresh tubercles are very apt to form around the ducts leading from the affected lobule, and also in neighbouring lobules.

Symptoms.—The course of the trouble is exactly the same as that where the disease occurs in the other tissues—namely, that the tuberculous mass usually increases in size, tends to break down at the centre, and forms a cheesy mass, and subsequently a chronic abscess. In the case of the breast there are usually several abscesses that ultimately reach the surface, thus leading to the formation of several sinuses; but, as a rule, the abscess remains in one section of the breast, and is not diffused over the whole organ. It seems to occur primarily in the breast, though in some cases it is secondary to tuberculous disease of the axillary glands, and most usually the external portion of the gland is the part attacked.

The disease begins insidiously. One or more swellings of irregular shape appear and increase pretty rapidly, the centre of these swellings becoming soft, and ultimately forming a chronic abscess. As in other deep-seated tuberculous affections, there is little or no pain. In most cases the axillary glands become enlarged, if they have not been enlarged previous to the onset of the disease, and they may undergo suppuration. If the condition be left alone, it ends in the formation of sinuses which have no tendency to heal, and around which the skin is undermined as is characteristic of tuberculous sinuses. Before suppuration has occurred it is difficult to diagnose the disease, more especially from cancer: but if the axillary glands are very large, or if they were enlarged before the appearance of the swelling in the breast, the probability is that we have to do with a tuberculous affection. Once suppuration has taken place, or sinuses form, there will be little or no trouble in diagnosis. The condition is a serious one, because, in the first place, if not arrested by treatment, it is apt to lead to destruction of the breast, while the constant discharge tends to weaken the patient, and further infection is very apt to take place. It is also a serious condition as regards the infant if the patient is still in the child-bearing period, because if the patient were to become pregnant, the milk secreted might contain and convey the tuberculous virus.

Treatment.—As regards the treatment of this condition, where the patient is in the child-bearing period the best treatment is to

excise the breast, because it can never be other than a source of danger to the child ; while treatment short of excision is rarely sufficient to effect a cure. Where the patient is old, and where the function of the gland will not come into play, and where the tuberculous disease is limited to a small portion of the gland, one may be justified in opening it up freely, and removing or scraping away the diseased portions as far as possible, stuffing the wound afterwards with iodoform gauze ; but in most cases, even in these circumstances, the surgeon is ultimately compelled to resort to excision with the view of obtaining a cure.

In connection with tuberculosis of the breast, I may mention *chronic submammary abscesses*, which usually arise in connection with tuberculosis of the ribs beneath. They form fluctuating swellings behind the mamma, projecting the breast forwards, and ultimately usually pointing towards the lower and outer edge of the breast. The diagnosis of this condition is not usually a matter of any difficulty, and the treatment is the thorough removal of the abscess wall, and of the affected portion of the rib.

Syphilis of the breast.—Syphilis in connection with the breast is most usually found in the primary stage, chancres not being at all uncommon on the nipples from nursing a syphilitic child. As a rule, chancre of the nipple can be readily recognised, but in some cases it is present in the form of a fissure, and this may be mistaken for a simple fissure. The chancre, however, is not so painful, and it is distinctly indurated, and from an early period of its existence the axillary glands are enlarged. It is a point of interest that, with rare exceptions, a syphilitic child does not infect its own mother, even although the mother has never at any time displayed any signs of syphilis, the probability being that the placental circulation has prevented the entrance of the syphilitic virus into the mother, but has permitted the passage of the serum of the child, and has thus produced a certain amount of protection. Condylomata are also not uncommon in the breast, occurring chiefly on the nipple or areola, or, in the case of pendulous breasts, at the fold of skin below the breast. Gummata have also been found in the breast, but very rarely.

Tumours of the breast.—Connective tissue tumours are comparatively rare in the breast, the simple forms, such as pure fibroma or *lipoma*, being occasionally, but very seldom, found. The *fibromata* of the breast are very probably often the result of an inflammatory condition (chronic lobular mastitis) which leads to destruction of the acini, and leaves behind a small fibrous mass. What was formerly described as fibrous tumour of the breast was no doubt in most cases a fibro-adenoma.

Sarcoma.—Of these connective-tissue tumours sarcoma is the most common. From 2 to 8 per cent. of breast tumours are sarcomata, and these present the same structure as sarcomata elsewhere. Most usually they are round-celled, but in some cases spindle-celled tumours have also been found. In the true sarcomata there is

no new growth of gland tissue, but occasionally a little may be found, having become accidentally included; the tumour sometimes has a spurious capsule, and pushes aside and leads to atrophy of the surrounding breast tissues.

These tumours occur generally in young women, and are seldom met with after the age of thirty. They form rounded tumours in the breast, which grow rapidly, and may at first have a spurious capsule; the capsule, however, being in reality part of the tumour. Subsequently they tend to infiltrate the tissues and project through the skin (Fig. 858).

In the early stage, sarcoma of the breast is not easily distinguishable from fibro-adenoma, but as time goes on, its rapid growth,



Fig. 858.—Fungating Sarcoma of the Breast. (After Billroth.)

rounded form, and tendency to infiltration of the tissues around lead to the diagnosis. From scirrhus sarcomata are more easily diagnosed by their more rapid growth, the much larger size which they attain, the absence of contraction, dimpling, or retraction of the nipple, the late involvement of the skin, their softer consistence, and their occurrence in young women.

The further history of these growths is the same as elsewhere, that is to say they tend to become generalised, more especially through the blood-vessels, but in some cases, and indeed not infrequently, especially in the round-celled form, the axillary glands may become the seat of secondary deposits.

The treatment of sarcoma of the breast is early removal of the whole organ. Attempts to save the gland by removing only the tumour are extremely apt to be followed by recurrence. If such an

attempt is made it must be borne in mind that, if a sort of capsule is present, it is part of the tumour, and must not be left behind.

Fibro-adenoma.—The most common simple tumour of the breast is the adenoma, or rather the fibro-adenoma. Pure adenomata are very rare, that is to say, tumours composed entirely of new growth of acini; indeed, most pathologists deny their existence entirely. I see no reason, however, for supposing that, as the result of some irritation, an excessive epithelial development, leading to the new development of acini, may not occur; I mean, that the primary change may be epithelial proliferation, and not growth of the interacinous connective tissue. In the great majority of cases, however, the epithelial tubes are more or less widely separated by a large amount of fibrous tissue, and the epithelial proliferation is more or less secondary, and hence the term fibro-adenoma is more correct than that of adenoma.

Varieties.—These fibro-adenomata present two forms microscopically: in the one the epithelial elements are chiefly in the form of

small clusters of acini, what is called the acinous adenoma (Fig. 859); while in the other the arrangement is chiefly that of tubes which may be more or less dilated and have numerous ramifications, the so-called tubular or canalicular adenoma (Figs. 860 and 861). In this latter form, more especially, the epithelial tubes tend to become dilated and form cysts, while from the wall of the space masses of fibrous tissue, covered with epithelium, project into the cavity, forming the so-called intra-cystic growths (Fig. 861). These growths are formed by proliferation of the fibrous tissue outside the basement membrane pushing forwards the wall of the duct,

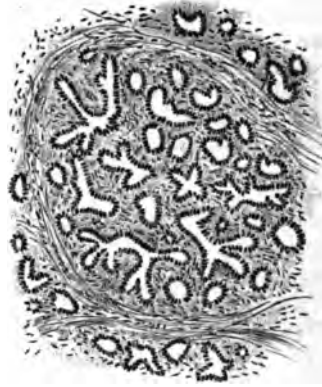


Fig. 859.—Acinous Adenoma of the Breast. (From a preparation by H. J. Stiles, Surgical Laboratory, Edinburgh University.)

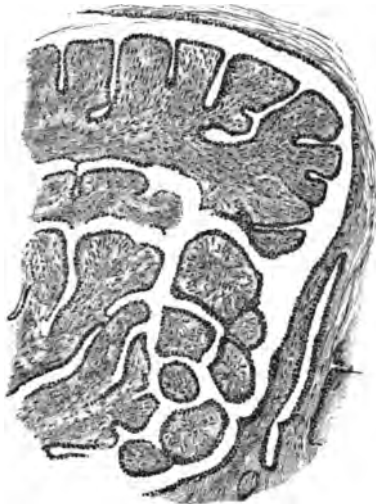


Fig. 860.—Tubular Adenoma of the Breast, showing wall of duct. (Stiles.)

followed by secondary development of epithelium; whether the reverse condition occurs—namely, growth of epithelium pushing its way into and breaking up the fibrous tissue—is very doubtful.

Aspect on section.—On making a section of an adenoma the surface is found to be broken up by spaces which, on microscopic examination, are seen to be these dilated tubes (Fig. 859). The cysts which form in these tumours contain a yellow serum, or more often a mucoid fluid, but if bleeding has occurred the material may be of a chocolate colour, or in other cases may be somewhat milky. In some



Fig. 861.—Tubular Adenoma of the Breast, showing intra-cystic growths. (Low power.) (Stiles.)

instances a cyst without any intra-cystic growths may increase rapidly in size, and lead to atrophy of the tumour around, and thus present the appearance of a simple cyst; indeed, according to most authorities, simple cysts of the breast are not merely dilations of comparatively healthy acini or tubes, but are due to cystic development in portions of the breast that have been previously

the seat of chronic mastitis, or in a small fibro-adenoma.

The nature of the tissue outside the ducts or acini varies in different cases. In typical fibro-adenoma this material is well-developed fibrous tissue; in other cases the fibrous tissue is soft and very cellular, and may present the appearance of myxomatous tissue, these tumours being called *myxo-adenomata*. These myxo-adenomata grow rapidly and may attain a large size. They are softer than the fibro-adenomata and hæmorrhages are very apt to occur in them. In other cases, again, the connective tissue may be quite elementary, and consists of more or less closely-packed cells, a condition which is spoken of by some as *adeno-sarcoma*. Some authors—for instance, Mr. Raymond Johnson—deny that these tumours really belong to the class of sarcomata at all, and look upon them as simply an embryonic condition of the fibrous tissue without any malignant

tendencies, and hold that the only sarcomatous tumour which occurs in the breast is the pure sarcoma, which contains no glandular elements whatever. Whether this be so or not I would not venture to say, for a considerable number of authorities still maintain the existence of these adeno-sarcomata, and state that they present malignant characters, giving rise to secondary growths which, however, do not contain any gland tissue.

Symptoms.—The fibro-adenomata are encapsuled tumours. They are generally single, but they may sometimes be multiple, and they vary from the size of a nut to that of an orange. They usually occur only in one breast. When they attain any considerable size they are often knobby in outline, from the presence of the cysts previously referred to. They most usually occur towards the periphery of the gland, and only very rarely in the deeper parts, hence they present the appearance of superficial tumours which are freely movable under the skin, which are firm, somewhat elastic, and not tender, though in some cases there may be somewhat slight, vague pains in connection with them. They are usually discovered accidentally. The axillary glands are not affected. They occasionally swell up during the menstrual period. These tumours are, as I have said, freely movable, and may be pulled away from the rest of the breast without causing any retraction of the nipple, a point of some importance in the diagnosis from tumours which are embedded in the substance of the breast, more especially cysts where, on attempting to push them towards the periphery, the nipple becomes drawn on. Nevertheless, even when quite peripheral, these fibro-adenomata are directly in connection with the breast, and one can usually find a band of tissue connecting the tumour with the breast. As a rule, after reaching a certain size these tumours remain more or less stationary, but where they are markedly cystic they may go on growing, as the result of the dilatation of the cysts. They are simple tumours, and their diagnosis is generally quite easy. From advanced cases of cancer there is no difficulty whatever in distinguishing them, but in the early stage it may not always be easy to distinguish them from a small cancer. Even in these cases, however, the fibro-adenoma is much more freely movable, rolling under the skin, and is very distinctly circumscribed. From chronic mastitis, also, they are distinguished by being less intimately associated with the breast than is the case with the inflammatory nodules.

As to the origin of the fibro-adenomata, some are probably inflammatory in origin, while others are due, according to Mr. Stiles, to an error in development—namely, the isolation of a clump of epithelium during the developmental budding of the parenchyma.

Treatment.—As regards the treatment, it is well in all cases to recommend removal, not that the tumour is itself a dangerous one, but because, if it increases in size, it may produce deformity, while its presence always weighs on the mind of the patient, who is constantly in terror lest it should become a cancerous tumour. The operation is a perfectly simple one, the adenoma being readily shelled

out of its capsule. I think, however, that in most cases it is best to remove the capsule along with it, because I do not feel absolutely confident that those forms where the inter-acinous tissue is extremely cellular may not in reality be sarcomatous, and recur if the capsule be left. Where the tumour is situated towards the upper part of the breast, and where a scar might be of some importance, the tumour can be usually removed without any visible scar by making an incision at the lower part of the breast, and, pulling forwards the breast, enucleating the tumour from behind.

Cancer of the breast.—The most important tumours of the breast are those belonging to the class of carcinomata.

Varieties.—There are two forms of cancerous tumours of the breast—namely, those which begin in connection with the acini, the ordinary *acinous carcinoma*; and those which begin in connection with the ducts, the *duct cancer*. The ordinary cancer of the breast belongs to the group of carcinomatous tumours which were formerly spoken of as scirrhus, that is to say, there is a great tendency to the development of young fibrous tissue in the cancerous growths, and this contracts and presses on the alveoli, and leads to atrophy of the epithelial cells; hence the centre of these cancerous tumours becomes converted almost entirely into a mass of fibrous tissue, while at the periphery, where the growth is taking place, we find large alveolar spaces containing epithelial cells, with only a very small amount of connective tissue between them.

Pathology.—These tumours commence in a lobule of the breast, probably from proliferation of the epithelial cells in the acini. These proliferating epithelial cells very quickly push their way through the wall of the acini, and spread into the surrounding tissue, most probably by getting into the lymphatic spaces and channels, and growing along them. Hence from a very early period of their development I believe that these cancerous tumours are really growths in lymphatic spaces, and thus it is that we have the early distribution of the disease along the lines of the lymph flow. According to some writers, the tumour extends in the vicinity, at any rate in the early stage, by fresh infection and fresh outgrowth from neighbouring acini rather than by spreading along the lymph spaces; but this is a view for which I have never seen any satisfactory evidence. If one examines the growing margin of the tumour, one can often see the neighbouring acini being pushed aside, the epithelium undergoing atrophy and disappearing; and for my own part I have not met with appearances which corroborate the view that these neighbouring acini are also undergoing cancerous transformation. This is a point of great practical importance, for on it depends the view which the surgeon will take as to the extent of operation necessary, more especially in the early stage of a cancerous affection. If the growth of the tumour is really due to fresh development of disease in neighbouring lobules, and if in the early stage the lymphatic channels are not penetrated into by the growth, it might not at an early period be necessary to remove the whole

breast, but only a wide area around the tumour, and certainly not the lymphatic tract or lymphatic glands.

On the other hand, if the view be taken that from the very earliest period cancer cells are developing along the lymphatic channels, however small the tumour, it becomes necessary to remove the whole lymphatic area, that is to say the whole of the breast, the lymphatic channels in the neighbourhood, and the nearest lymphatic glands. The latter view is undoubtedly the one supported by clinical evidence, because in the great majority of cases where only the tumour itself is removed recurrence takes place, either in the breast itself, in the pectoral fascia, or in the lymphatic glands in the axilla ; while, on the other hand, where a complete operation is done at a comparatively early period, a very much larger proportion of cases remains ultimately free from the disease, and local recurrence is very uncommon. Further, we know, from the results of injection of the lymphatics, that from an early period there is free communication between the lymphatic vessels and the alveoli of the cancerous growth, a communication so free that it can, I think, only imply that the alveoli are nothing more or less than dilated lymphatic spaces.

These cancerous tumours in the breast seldom attain any very large size, and this is to a great extent due to the fact to which I have already referred—namely, the large amount of fibrous tissue which has formed towards the centre of the tumour, its subsequent contraction, and the atrophy of the growth as a result. The further history of these tumours is that they infiltrate the surrounding parts, which become diseased, while at the same time the cancerous material is carried along the lymphatic vessels, giving rise to growths along their course, more especially in the pectoral fascia, and it subsequently reaches the nearest lymphatic glands, in most cases the glands of the axilla.

Symptoms.—Clinically, the appearance of a cancer of the breast is a small tumour, seldom larger than a hen's egg, and generally a good deal smaller, which is of stony hardness and ill-defined, and from which one can often feel strands of hard tissue radiating into the breast in various directions. On cutting across the tumour it generally creaks under the knife, and gives the sensation as if one were cutting fibro-cartilage. On looking at the cut surface it will be seen to be concave from the contraction of the fibrous tissue on each side. Towards the centre it presents a dense, fibrous appearance, and is of a whitish colour, speckled with little fatty points. Towards the periphery it is softer, and of a duller slate colour, with here and there portions of fatty tissue. The little fatty points seen in the centre are the degenerated epithelial cells in the alveoli, and the fatty tissue towards the periphery is the normal fatty tissue between the lobules of the gland, which has been enclosed by the irregular growth of the tumour. The presence of these islets of fatty tissue is very characteristic of carcinomatous tumours, and they are not found in sarcomata or simple tumours such as fibro-adenomata. On scraping

the surface of the growth a milky fluid—the so-called *cancer juice*—will be obtained.

At a very early stage the skin over the tumour is freely movable, and there is no retraction of the nipple; but as time goes on the bands of fibrous tissue which connect the breast and the skin (the suspensory ligaments of Astley Cooper) become involved in the growth, and pulled upon as the fibrous tissue contracts, so that before very long the skin over the tumour does not move absolutely



Fig. 862.—Cancer of the Breast, showing wrinkling of the skin. (From a photograph.)

freely, but on attempting to push the tumour to one side or the other it will be seen that the skin tends to be drawn in as the tumour moves, although it is not yet actually infected (Fig. 862). This *puckering of the skin* over the tumour is a very marked diagnostic feature in cancer of the breast, and the only other cases in which it is met with are those of marked and extensive inflammatory infections, where the skin has actually become adherent to the inflammatory mass. As time goes on, not only does the skin pucker on movement, but the suspensory bands become more and more drawn upon, so that *dimples* may be formed in the skin over the tumour, which are perfectly evident without moving the growth at all (Fig. 863). Further, if the tumour is situated towards the centre of the breast, the milk-ducts become involved in the growth, and drawn

upon as the centre contracts, and consequently we have the typical appearance in cancers in the substance of the gland—namely, the *retraction of the nipple*. As a rule, this retraction is greatest at the part of the nipple nearest the tumour, the nipple not being equally depressed all round. Where the tumour is situated at the periphery of the gland, however, it may have lasted a long time, and attained a considerable size without causing any retraction of the nipple. The only other case in which this retraction of the nipple is found is in chronic inflammation, but there the process is much more diffuse,

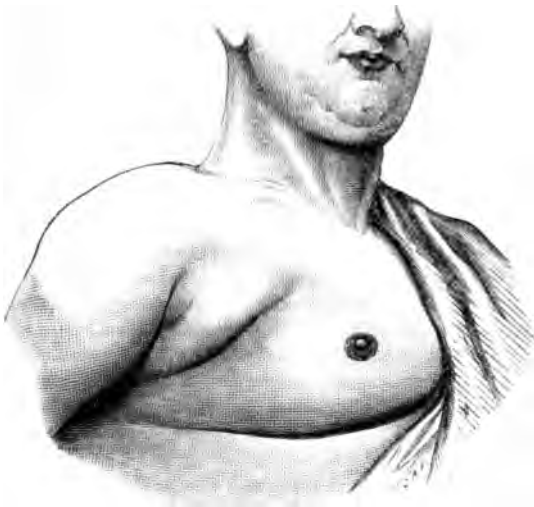


Fig. 863.—Cancer of the Breast, showing retraction of the skin over the tumour at the axillary end of the breast.

and other signs are present, which lead one to diagnose the inflammatory condition.

The most striking evidence of the great contraction which occurs in these cancerous tumours is the fact that, although the breast may be occupied by a considerable amount of cancerous material, it generally appears *smaller* than the healthy breast, and, indeed, in cases of atrophic cancer the breast may have almost disappeared, having been drawn into the cancerous mass. Even at a comparatively early period of the disease, when the parts are looked at from the front, it will be found that the diseased breast is not only somewhat smaller, but is also less pendulous than the healthy one.

In the ordinary acinous cancer it is not common for the patient to have any *discharge from the nipple*; but, as will be presently mentioned, the existence of a bloody discharge is one of the characteristic features of duct cancer.

As time goes on, the skin over the tumour tends to become involved in the cancerous growth, and then, instead of a depression at the part, one finds a projection of the skin, which is red and hard, and, in fact, is a cancerous nodule. Once this condition has been established, ulceration very soon occurs over the projecting swelling, and we have the typical *cancerous ulcer* of the skin; this is usually a depressed ulcer, with an unhealthy, somewhat sloughing base, and hard and overhanging margins.

In other cases preceding the actual adhesion of the cancerous tumour to the skin, the skin over the part may become œdematous and red without, so far as the microscope shows, any actual cancerous affection. Usually, however, such a condition precedes the diffuse development of cancer in the skin, the condition spoken of as *cancer en cuirasse*. In this form of disease the skin over the cancer, in the first instance, becomes hard, brawny, and red from diffuse infection of the lymphatic system of the skin with the cancerous material, and this brawny condition of the skin may rapidly extend over the whole of the side of the thorax without any ulceration in the early stage. In other cases the affection of the skin is not due so much to direct spread of the original cancerous tumour to the skin as to the development in it of numerous nodules, probably from the cancerous material being conveyed along the lymphatic vessels in the suspensory ligaments, and affecting the deep cutaneous plexus of lymphatics. This condition, where numerous nodules are found in the skin over cancer of the breast, generally also ends in *cancer en cuirasse*. Very often in these cases the primary tumour is small, and belongs to the type of atrophic scirrhus. It is often situated under the nipple, and cannot be felt on account of the thickened leathery condition of the skin.

Usually, after the disease has lasted about six months, *enlargement of the axillary glands* will be felt, the glands first affected being those running along the edge of the pectoralis minor. These glands are generally numerous, but seldom attain any great size; in some cases, however, especially in softer rapidly-growing cancers, they may form large masses, much larger than the original tumour. They are very hard and, in the first instance, freely movable. This infection of the glands continues to extend till the whole of the axillary lymphatic system is involved, and from that the disease spreads up into the glands at the lower part of the posterior triangle of the neck, and subsequently to the mediastinal glands.

While this infection of the lymphatic glands is going on, the tumour in the breast, more especially where it is deeply seated, tends to become *adherent to the pectoral fascia*, and subsequently to the pectoral muscle; and thus, not only is disease to be found in the axillary glands, but various deposits also take place in the pectoral fascia. In the first instance, these deposits are only recognised by the microscope, but they go on growing, and at a later period appear as minute nodules over the muscle. When the tumour has become adherent to the muscle itself, the muscular lymphatics also become

involved, and nodules appear in the substance of the muscle itself. This adhesion of the gland to the pectoral fascia occurs at a comparatively early period in most cases, and is a point of great importance with regard to the operation; because, once it has occurred, one must look on the whole lymphatic system of the pectoral fascia as infected. This condition is readily diagnosable if the patient is made to stretch out the arm so as to render the pectoral muscle tense. It will then be seen that, while the tumour can be moved transversely to the muscle, it cannot be moved in the direction of the muscular fibres, a point which will be overlooked if the examination is made with the arm hanging by the side, and without the muscle having been rendered tense.

On an average, after the growth has lasted about two years—at any rate in rapidly-growing cancers—*secondary deposits* will appear in the internal organs, more especially in the liver, in the pleura, and in the bones; and the bone most frequently affected is the sternum, towards the upper part of the manubrium sterni; the humerus and the ribs are also not unfrequently attacked.

These growths are usually associated from a very early period with characteristic *stabbing pain* coming on in paroxysms, and it is generally the existence of these pains which leads the patient to examine the breast and discover the tumour; but in a considerable number of cases the growth is free from pain, and is only discovered accidentally.

In the early stage the patient usually remains in good health, but after the disease has lasted some months the health gives way, the patient becoming weak, losing flesh, and assuming a pale, earthy, cachectic appearance. This condition of *cachexia* does not necessarily imply infection of the internal organs, and it is probably due to poisoning of the system with substances formed in the cancerous growth. Certainly, I have in more than one instance removed the breast and axillary glands in patients who had marked cachexia, and subsequently to the operation this cachexia has very much improved, and in some cases disappeared; hence the presence of the so-called cancerous cachexia can hardly of itself be reckoned as a contra-indication to operation, as is done by some authors.

As a rule, the cancer remains limited to the breast which is first involved, and spreads in the directions that have been described, but in a certain number of cases a *cancer is found in the opposite breast*, and that even at a comparatively early period of the disease. When this is the case, it has been generally looked upon as implying very grave constitutional infection, and the fresh development of cancer in the acini of the opposite breast. As a rule, however, where the second breast becomes involved at an early period, the original cancer is situated towards the sternal end of the breast first affected, and it seems most probable that the tumour which develops in the second breast does not arise from a fresh growth of epithelium in the acini, but is due to infection of the lymphatic system of the second breast from the original tumour. In cases where the mamme

are large, it appears that there is comparatively free communication between the lymphatic vessels of the two sides; and it has been found in some cases that, although there was no disease in the second breast, the lymphatic glands in the axilla on that side had, nevertheless, become enlarged from cancerous deposit, not very long after the development of the disease in the glands on the side affected. This can only imply that the lymphatic infection has been carried directly to the opposite axilla, without having infected the breast in its course, and that fact is additional evidence in favour of the view that the infection of the second breast is in most cases, at any rate, merely an accident in the distribution of the disease by the lymphatic vessels. This is an important clinical point, because

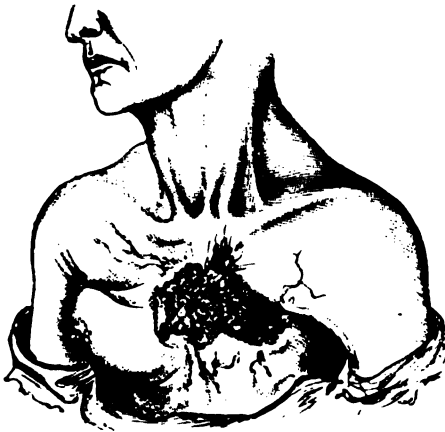


Fig. 864.—Atrophic Scirrhus of the Breast.

on this view the infection of the second breast does not render the prospect of cure by operation hopeless, as would be almost certainly the case were it a fresh development of cancer independently of the original disease.

So far I have described the typical course of an ordinary acinous cancer, but the disease varies very much in its course and rapidity in different cases. Where the disease commences in young women before the age of thirty, it generally goes on with great rapidity, and the tumour

does not show the same tendency to contraction and atrophy as in older patients; on the other hand, more especially when the cancer begins in old people, the course of the disease may be much slower, and in certain cases, indeed, it is so slow, that the name *atrophic scirrhus* is given to these cases (Fig. 864). This form of cancer is of very slow growth, and patients may live even as long as twenty years from the commencement of the disease. The tumour in the breast does not attain any very large size, but the breast itself gradually shrivels up, and after the disease has lasted some years, hardly any breast-tissue is left. The skin generally ulcerates over the tumour after a time, but a long period elapses before the axillary glands become infected. As a rule, towards the end of the case secondary growths are found in internal organs, and the patient dies of these internal tumours; and in some cases, also, the original tumour, which may have gone on slowly for years, may suddenly take on a more rapid growth and follow the ordinary course of acinous cancer.

The local appearances of cancer of the breast may also be considerably modified by the occurrence of various forms of degeneration in the cancerous growth. It is not very uncommon for *cysts* to form in cancers, especially in the large rapidly-growing forms, these being due to hæmorrhage into the tumour. They are not cysts in the true sense of the word, and the condition is often erroneously spoken of as "cystic sarcoma." Such an occurrence has led to errors in diagnosis, these cystic cancers having in some cases been mistaken for abscesses where the tumour was rapidly-growing; and in other cases for simple cysts where the tumour was small, and where the cyst contained a more or less clear fluid. With regard to this latter point, it may be mentioned that a cancer may form around a pre-existing cyst.

The *colloid form of cancer* also occasionally, though rarely, occurs in the breast, usually in younger women, and there the disease is generally less malignant than the ordinary form of cancer, growing more slowly, and not leading to such early infection of the glands. In these tumours the contraction of the inter-alveolar tissue is absent, the tumour may be softer than the ordinary cancer, and somewhat bossy, though sometimes it is quite hard; it is rather more circumscribed, and projects the skin instead of leading to the formation of dimples over it. In some cases there is a bloody discharge from the nipple.

Duct carcinoma.—I have already referred to the other form of cancerous growth in the breast, namely, duct cancer. This is a rare condition, and attention has been directed to it, in England more especially by Mr. Bowlby.

Pathology.—Much discussion has also arisen as to the malignancy of the disease, and as to its relation to duct papilloma. In certain cases one meets with small tumours projecting into the milk-ducts, with a very narrow pedicle, and with numerous spaces in them containing epithelial cells. These are the typical duct papillomata. In some cases, however, a tumour which commences in this way as a projection into one of the large ducts tends also to infiltrate the tissues around the duct, leading to the formation of tubes lined with epithelium, with an appearance resembling that of columnar epithelioma, as seen in the rectum. When this infiltrating form is met with, the condition is looked on as malignant, and it is spoken of as a duct cancer.

Symptoms.—These duct cancers are generally met with in elderly females, and the attention is usually first attracted to the fact that anything is wrong by discharge from the nipple, the characteristic discharge being blood-stained. This condition of bloody discharge from the nipple is common to the duct papilloma and the duct cancer, but occurs more especially in the latter.

On examination of the breast at an early stage nothing may be at first discovered, but later a small tumour can generally be found towards the centre of the breast, beneath the nipple or areola. In some cases these tumours are multiple. In the cases described they

have seldom attained a large size, and in only one or two has there been any affection of the axillary glands. The disease is apparently less malignant than the ordinary cancer, and goes on more slowly, but instances are on record where local recurrence has taken place more than once after excision of the breast by the ordinary method. In these cases the diagnostic points are the flow of blood from the nipple, and the presence of minute firm tumours at the centre of the breast.

Treatment.—In such a case the nodule, at any rate, should be at once excised in the first instance, and if it is found to be infiltrating the tissues around the duct, the excision of the whole breast should be carried out. If the case is seen at an early stage, one may perhaps make this an exception to the ordinary rule that the axillary glands should be removed at the same time as the breast.

Ætiology of carcinoma.—Cancer of the breast is essentially a disease of the female, only about 1 per cent. of the cases occurring in males; and in women the breast is one of the most common seats of cancerous disease. According to Mr. Bryant, two out of every five cases of cancer in women occur in the breast. This disease is essentially one of advanced life, the great majority of cases commencing between thirty-five and sixty years of age; only a very small proportion begin before thirty—something like 4 per cent., according to Mr. Bryant—or after sixty, but so far as I am aware, the true relation to age has not been accurately worked out, for although only a small number of cases are met with commencing after sixty, as a matter of fact only a very small proportion of women are alive after that age. In the great majority of cases, also, the patients are married women, and women who have borne children. In most of the statistics the proportion of married to unmarried is about eighty to twenty, and in Mr. Bryant's statistics of the cases which occurred in married women, 74 per cent. affected those who had borne children, and 26 per cent. those who were sterile. Here, again, the statistics are not of any particular value, because the proportion of married and unmarried women has not been calculated out, nor in those who are married the proportion of prolific and sterile.

Heredity is looked on as of considerable influence, but Mr. Bryant, in a series of 600 cases, only got a history of cancer in the family in 12 per cent.; nevertheless, there are a number of cases where several members of one family become affected with the disease. Supposing cancer to be a parasitic disease, the relation to heredity is probably very much the same as that of tuberculosis—namely, that on the one hand the descendants of those who had died of cancer may be more susceptible to the infection; and on the other hand, continuing to live in the same house with cancerous individuals, they may be more exposed to infection. Quite recently several instances of so-called “cancer houses” have been recorded, where families living in houses where persons had previously died of cancer had also become subject to the disease, the assumption being that in these

houses infective material had been left behind by those who had previously died of this affection.

The presence of a source of irritation is looked on as one of the causes of cancerous disease, and this view is undoubtedly supported by the facts with regard to epitheliomatous disease of various parts of the skin and mucous membrane, such as cancer of the lower lip from smoking, chimney-sweep's cancer, etc. Some authorities extend this view also to cancer of the breast, and look on the large proportion of cases which have occurred in prolific women as due, to some extent, to the irritation of the breast by repeated lactation, and to attacks of mastitis in connection therewith. Some authors—for example Sir James Paget—also lay great stress on the power of the mind in leading to the occurrence of cancer, by the transformation of what may be apparently a comparatively simple nodule into a cancerous growth. Locality, also, seems to have a considerable influence in the development of the disease, and this is certainly a fact which seems to support to some extent its supposed parasitic origin. Apparently the disease is comparatively rare in certain countries, more especially in warm climates, and it seems to be most common in valleys and along the banks of rivers, especially of rivers that overflow their banks.

The reputed parasite of cancer.—Quite recently various authors have described bodies in connection with the epithelial cells of cancer, which they look on as parasites and which are supposed to belong to the lowest forms of animal life. These are spoken of by some as "psorosperms," by others as "cancer bodies"; and they have been described, in England more especially by Dr. Ruffer, who speaks of them as "the parasite of cancer"; according to him, they are found either in the protoplasm of the epithelial cells or, in some cases, in the nucleus. He states that the characteristics of the full-grown protozoon are the presence (1) of a central, round, oval, or slightly-irregular nucleus, sometimes connected by fine, delicate rays with the periphery; (2) of a variable amount of surrounding protoplasm, almost, if not quite, filling up the capsule; and (3) of a double-contoured capsule. These bodies seem to lie in spaces in the epithelial cells, or in some cases, according to Ruffer, in the nucleus itself. Most usually there is only one in the cell, but there may be several. Lying in the cell protoplasm they increase in size, and flatten out the nucleus of the cell, which ultimately becomes destroyed. Although Ruffer and his coadjutors speak of these as cancer parasites, it has not yet been definitely proved that they are in reality living organisms; some, on the contrary, holding that they represent degenerative processes in the cell, others considering that they are cell inclusions. Certainly, beyond the fact that these bodies can be found in all cancers, especially in the growing part, while they have not as yet been demonstrated in other tissues, no other proof of their parasitic nature has been furnished. (Dr. Hebb has, however, described similar appearances in a case of fibroid

thickening of the omentum.) It has been said that amœboid movement has been noticed, and that there are evidences of multiplication by division, but none of the other necessary postulates for the proof that a micro-organism is the cause of the disease, even supposing these to be living organisms, has been furnished in this case. Some authors speak of these cancer bodies definitely as psorosperms, and consider that they belong to that group of protozoa, and the most wonderful descriptions have been given of spore formation and other changes, which, however, have not been able to bear the test of careful examination. At the present time, while one must admit

the possibility that cancer is a parasitic disease, and that these bodies described by Ruffer and others are the parasites of the disease, there is no real evidence in support of that view.



Fig. 865.—Section of Areola from a Case of Paget's Eczema.

Paget's eczema of the nipple.—In connection with the aetiology of cancer, we must also refer to the peculiar ulcerative disease of the nipple which was first described by Sir James Paget, and which is spoken of as "Paget's ec-

zema of the nipple," and which is apparently often associated with or followed by cancer of the breast. This disease, according to Paget, affects the nipple and extends on to the areola, the affected surface becoming intensely red and raw, and very finely granular, and exuding a copious, clear, yellowish, viscid discharge. After a time the disease may extend beyond the areola, and it resists all treatment, both local and general. According to Dr. Thin, the disease is not a true eczema of the skin, but is a malignant dermatitis, in reality a cancerous change in the papillary layers of the skin (Fig. 865). In most cases this disease is associated with cancer, and some state that cancer is the first occurrence—most usually a duct cancer—and that it is the exudation from the nipple and the material from the cancerous focus which leads to the infection of the skin. Others, on the contrary, state that in many cases the ulceration of the nipple has lasted for some considerable time before any tumour has appeared in the breast. In any case, so constant is

the relation between cancer of the breast and this condition of the nipple, that many surgeons advise immediate removal of the breast in cases of Paget's disease, even though no tumour can be discovered in it. In cases where a tumour is discovered, it generally lies under the nipple, and is, in the first instance, quite small, and not uncommonly of the variety known as duct cancer. It was in this disease that the so-called psorosperms were, in the first instance, found in the epithelial cells of cancer, and it was from the observation of the appearance of the epithelium in these cases that observers were led to study the epithelial changes in cancerous tumours.

Diagnosis of cancer of the breast.—The diagnosis of cancer of the breast is in most cases comparatively easy where the disease is at all advanced. The presence of a hard tumour, ill defined, but not extensive, with puckering of the skin on attempting to move the tumour, and more especially with dimpling of the skin, and, if situated towards the centre of the organ, with retraction of the nipple, is almost pathognomonic. The only condition which produces anything at all approximating to this appearance is an inflammatory condition of the breast, but there the swelling is diffuse and extensive, it is tender, the breast is enlarged instead of being contracted as in the cancerous condition, and where dimpling is found in such a case there are often scars indicating old abscesses. The real difficulty in these cases is where we have to do with a large degenerating cancer. Further light is thrown on the matter by the examination of the axilla. The early enlargement of the glands—that is to say within a few weeks after the commencement of the disease, provided the commencement can be really determined—indicates an inflammatory affection; and further, in the inflammatory condition the glands are often larger than the carcinomatous glands, unless in young subjects and in rapidly-growing cancer, and are tender and not usually numerous.

The presence of a discharge of bloody fluid from the nipple is highly suggestive of a cancerous disease; the presence also of marked cancerous cachexia, and of shooting pains as compared with the throbbing pain and tenderness of an inflammatory affection is also of importance. In some cases it may be very difficult to diagnose a tense cyst from a cancerous tumour. In the case of the cyst, however, we have a rounded tumour which is usually well defined, and there is no puckering or dimpling of the skin over it; whereas, as I have pointed out, these are very early occurrences in carcinoma. The presence of a cyst can, of course, be always diagnosed by tapping the tumour. An adenoma of the breast generally occurs in younger subjects, and it is very freely movable under the skin, and in neither the adenoma nor the cystic disease do we have enlargement of the axillary glands. If there be any doubt whatever as to the nature of the nodule in the breast, the surgeon should at once advise an exploratory incision. If it should turn out after all that it is an inflammatory affection, this treatment is the one which will most quickly lead to a cure of the disease; and if,

DISEASES OF THE BREAST.

on the other hand, it turns out to be a cancerous growth, the sooner the condition is recognised the better.

Treatment of cancer of the breast.—The treatment of cancer of the breast consists, of course, in the removal of the disease as early as possible, but there are certain cases in which operation is not advisable, and we may consider these in the first instance. Where it is evident that secondary deposits have formed in internal organs, there is no object whatever in excising the breast, unless it be that it is ulcerated and causing a great deal of pain, in which case the diseased portion may be removed as a palliative measure, without making any attempt to relieve the patient of the entire disease. Even although the internal organs are not known to be affected, where the disease has reached and affected the glands in the posterior triangle of the neck it is useless to attempt the removal, because by the time these glands have become sufficiently enlarged to be felt, the disease has certainly passed into the mediastinal glands or into the internal organs. Again, in cases of extensive *cancer en cuirasse*, the infection of the lymphatic system of the skin is so extensive, that even though it were feasible to remove the whole of the affected part of the skin and all the affected glands, still the disease extends so far beyond what is visibly affected that it would probably mean removing an enormous amount of skin without any real prospect of ridding the patient of the disease. According to some surgeons, also, it is inadvisable to remove typical atrophic scirrhus. This view, however, I cannot agree with, unless in cases where the patient is old or very feeble, because where patients live long enough with this condition, they generally ultimately die of the disease in internal parts; and if the whole of the local disease be removed, the patient has an especially good chance of being freed from the affection.

The usual objection that is given against operation in atrophic scirrhus is that after removal the disease grows more rapidly, but that is only to say, in other words—after *incomplete* removal. If the disease is completely removed in the way which I shall presently describe, the disease cannot grow more rapidly, and in no case should I advise operation in cancer of the breast where there is no reasonable prospect that it can be completely removed, unless, indeed, as I have said, in rare instances in which the local disease is the cause of serious pain and discomfort to the patient.

Where it is thought advisable to remove the disease, that is to say, where there is a considerable probability that one can get beyond the whole affected area, the operation must be done thoroughly and extensively in the first instance, and of late the researches of Heidenhain, Stiles, Raymond Johnson and others have shown us much more definitely than formerly exactly what and how much to remove. Before describing the operation, I may recall what I have previously said with regard to the mode of spread of the disease.

From a very early period of the commencement of the tumo

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the disease gets into the lymphatic system, and becomes distributed along the course of the lymphatic vessels, and caught in the nearest lymphatic glands. It is, therefore, absolutely essential, if anything like certainty is to be obtained with regard to the result of the operation, that the whole lymph area up to and including the nearest lymphatic glands should be removed, and I must, therefore, very shortly refer to the distribution of the lymphatics of the breast. According to Sappey, the lymphatic vessels of the breast begin in the form of small plexuses around the acini of the gland, these vessels then joining others from adjacent acini and running along the ducts, forming plexuses around them, till they reach the nipple. Thus the lymph from all the parts of the gland, even the outlying lobules, is

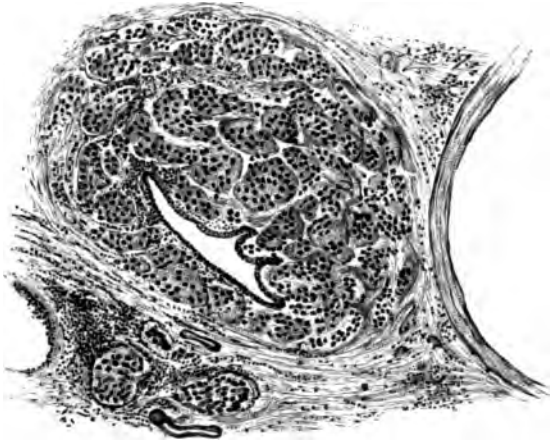


Fig. 866.—Section of Nipple from a Case of Cancer of the Breast, showing the cancer cells spreading along the lymphatic vessels around the duct, not in the duct. (Stiles.)

carried, according to this author, in the first instance to the nipple (Fig. 866). At the nipple the lymphatic vessels pass into a plexus situated beneath the areola, termed by Sappey the subareolar plexus, and from this plexus three or four large lymphatic vessels carry the lymph from the breast, and also from the skin in the vicinity to the axillary glands. Since Sappey's description, which still remains in part correct, it has been found, more especially by pathological and clinical investigation, that there are other paths by which the lymph is conveyed from the breast. Thus it seems that lymphatics run from the plexuses around the lobules of the breast, along the suspensory ligaments of Astley Cooper (Fig. 867), and join the plexuses in the deeper part of the skin; and in cases of cancer, plugs of cancer cells have been found in lymphatic vessels in these ligaments. The most important method, however, in which the lymph is carried to the axillary glands—at any rate from an operative point of view—is by lymphatic vessels, which leave the

deeper part of the glands and join the lymphatic plexuses in the pectoral fascia, and this seems to be one of the most common paths by which the infection of the axillary glands is brought about in cases of cancer of the breast.

It is clear, therefore, that in order to remove the disease, the whole lymphatic plexus of the breast must be taken away, because, from Sappey's work, it is evident that the cancer cells may be carried towards the nipple, and pathological evidence shows that in certain circumstances—probably of the blocking of lymphatic

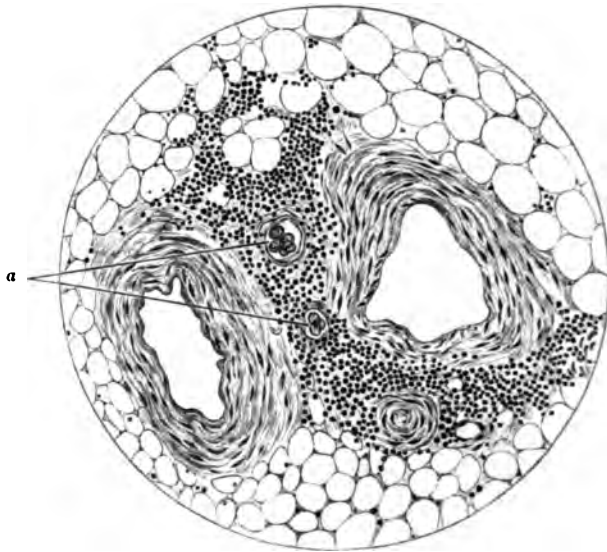


Fig. 867.—Section of Band of Fibrous Tissue (suspensory ligament) running from the Breast to the Skin, showing at *a* cancer cells in two lymphatic vessels. (Stiles.)

vessels—there may be a reflux of lymph from the centre of the breast towards the periphery, and that cancer cells that are being carried by the lymph may be driven back again and deposited in other parts of the breast. Hence it is absolutely essential in all cases of cancer of the breast, however small and however apparently localised, that the whole breast should be removed. In connection with this point, it has been found that the breast is a much more extensive organ than has been supposed, and that outlying lobules of the breast may extend in the fat around for a very considerable distance, and are always left behind when the breast is excised in the ordinary method described in the text-books of operative surgery.

Further, what I have just said with regard to the flow of the lymph towards the skin along the suspensory ligaments shows that the skin should never be dissected away from over a cancerous

tumour of the breast, otherwise the suspensory ligaments will be cut across, and portions that have already become infected may be left behind; and this is probably the chief cause of recurrence after operation where the recurrence takes place in the form of nodules in the skin. Hence in making the skin incisions for the removal of a cancerous breast, one must arrange them so as to take a wide area of skin from over the region of the tumour. All those portions of the skin which pucker on attempting to move the skin over the tumour, or the tumour under the skin, must be taken away, and not only those portions but a considerable area around.

Apart from the necessity of removing all the skin over the affected area of the breast, I do not think that it is possible to remove the whole of the gland itself by the ordinary oval incision, and I think that in all cases the incisions for the removal of the breast should include the skin over the whole of the prominent part of the organ. Where this is done, the skin is lifted from the deeper parts for a wide area beyond, and there is very seldom any difficulty in bringing the edges together afterwards by means of button sutures; and if the edges of the skin cannot be brought together in all parts, the small area left behind can be readily closed by means of skin grafts (Fig. 868).



Fig. 868.—Case showing Result of Skin Grafting after extensive Excision of the Mamma, a month after the operation. The wound has healed.

I have already remarked that an essential part of the lymph from the breast is carried to the axilla by lymphatics situated in the pectoral fascia (Figs. 869 and 870), and it is as important to remove these lymphatics as it is to remove the breast itself; and in order to do this it is necessary to remove the whole of the pectoral fascia co-extensive with the breast. It is all the more necessary to do this, because, as pointed out by Heidenhain, the deeper lobules of the breast penetrate into and are intimately connected with the pectoral fascia,

and if the breast is simply peeled off, not only are lymphatics left which are in all probability infected, but lobules of the breast also remain behind in large numbers. The removal of the pectoral fascia is not quite a simple thing, because it is intimately connected with the surface of the pectoral muscle, and, as Heidenhain has indicated, in order to take the fascia with the contained lobules of the breast and lymphatics away completely, it is necessary to take a thin layer of the superficial muscular fibres of the pectoral muscle.

Lastly, the operation is not complete, that is to say the patient



Fig. 869.—Section of Pectoral Fascia, showing at *a a* lymphatic vessels blocked with cancer cells. (Stiles.)

does not have the best chance of non-recurrence, unless the axillary lymphatic glands are also removed at the same time; because, even although they may not be found to be enlarged, it has been repeatedly demonstrated microscopically, more especially by Mr. Stiles, that early infection may be taking place in them; and clinically we know that in the great majority of cases, if they are left behind, they will subsequently enlarge, and if one waits till this takes place before removing them, the patient's chance of subsequent freedom from the disease is very greatly diminished. Hence, I would strongly advise in all cases of cancer of the breast that the whole of the axillary glands should be taken away, and, of course, all the fat and fascia running from the margin of the breast to the axillary glands should also be included, seeing that it contains the lymphatic vessels which are going to these glands (Fig. 871).

The operation.—The operation then for cancer of the breast—even in the case of the smallest tumours—must consist in the removal of a wide area of skin over the tumour, of the skin over the prominent part of the breast, of the whole organ itself, bearing in mind its wide distribution, of the pectoral fascia, and a thin layer of muscle under it co-extensive with the breast, of all the fat and fascia running from the breast to the axilla, and of the axillary glands themselves; and in the latter case the surgeon should not be content with picking out individual glands from among the fat of the axilla, but should deliberately dissect out the whole fat with its contained glands from the axillary space. This is most readily done by leaving the breast in connection with the axillary fat and fascia till the end of the operation. The weight of the breast tends to pull down the contents of the axilla, and when the dissection of the axillary space commences, I have always found it best to begin at the outer end by defining the axillary vein, because the glands lie in close connection with the vein, and having defined the axillary vein on the outer side, it is readily followed up to the apex of the space, and all the fat, with any glands contained in it, is removed from below and around that vessel.

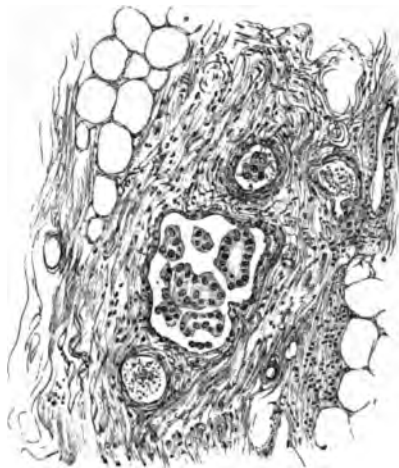


Fig. 870.—Lymphatic Vessel in Pectoral Fascia, containing several groups of cancer cells. (Stiles.)

An extensive operation of this kind is objected to by some surgeons on account of its risk, but, as a matter of fact, if the operation be performed strictly antiseptically, there is no more risk than after excision of the breast itself. True, in weakly patients there may be a certain amount of shock after the operation, but that is a matter or the surgeon to judge, in the individual case, as to whether he shall or shall not on that account complete his operation. The object of the operation should be, not merely to prolong life, but to obtain a cure, and it is worth the patient's while therefore to run a certain amount of risk. The rule, however, in my opinion ought to be absolute that, wherever possible, however small the mammary tumour, a complete operation must be performed. Acting on that rule, surgeons have recently obtained very much greater success as regards the non-recurrence of the disease than was the case formerly. Statistics are now given, extending over a considerable number of years, according to which in some cases over 30 per cent.

have remained free from the disease, and have, as far as one can judge from previous clinical experience, been cured. In my own work I have now 57 per cent. of cases remaining free from the disease after more than three years. Volkmann, as the result of his clinical experience, has stated that the great majority of recurrences after operation take place within a year, that if the patient remains free from the disease for two years there is a considerable probability that it will not recur; that if she remains free for over three years, this probability is converted almost into a

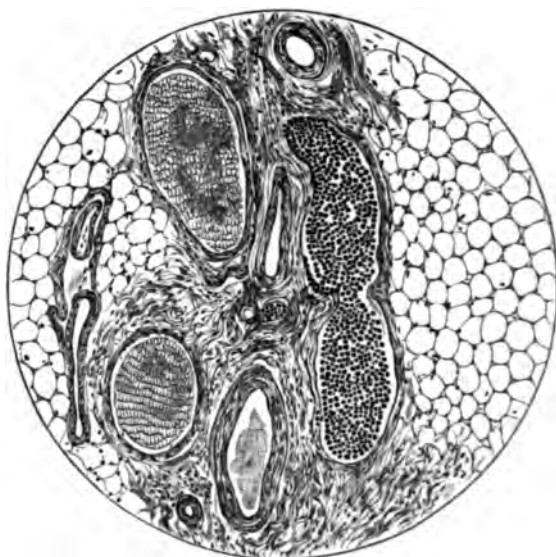


Fig. 871.—Axillary Tissue, showing a long lymphatic vessel full of cancer cells.
(Stiles.)

certainty. On the assumption that cancer of the breast is a local disease (and that view is held by the great majority of surgeons), it seems self-evident that the whole possibly infected area must be removed, and that, if this is done at a comparatively early period of the disease, the chances of the patient's remaining free must be enormously increased over those where only a partial operation is performed. As a matter of fact, where local recurrence takes place, it is either in the form of nodules in the skin—due in most cases, as I have said, to infected skin being left behind, especially infected suspensory ligaments—or it takes place deeper; and Heidenhain and others have investigated the latter cases closely, and have stated that in all instances these recurrences take place in connection with portions of the breast-tissue left behind, or in the pectoral fascia; or it takes place in the axillary glands. This being the case, it stands

to reason that particular attention should be paid to the thorough removal of the disease in those three directions.

Where the disease is so extensive that the whole of the pectoral muscle must be removed, or that the clavicle must be divided, with the view of removing glands from the deeper part of the neck, or that the arm must be amputated on account of the involvement of the axillary vessels and nerves, the chances of the permanent recovery of the patient are so very slight that I doubt if the operation is justifiable. With regard to the amputation of the arm for advanced cancer of the axilla, that was, I think, first done some fifteen years ago by Sir Joseph Lister, and the patient died of shock. Quite recently, in a recurrent cancer in the axilla of a man, I found, on opening the axilla, that the vein was firmly embedded in the cancerous mass, but that the point of entrance of the cephalic vein was free. I therefore tied the vein just below the point of entrance of the cephalic vein, and at the humeral end. After doing so, however, I found that the artery was equally involved in the growth, and I removed the whole length of the axillary artery. The nerves were not affected in that case. The circulation returned in the arm within twenty-four hours, and the patient made a perfectly good recovery; and it seems to me that, seeing it is possible to remove both axillary artery and vein without the loss of vitality of the arm, it can hardly be necessary to amputate the arm at the shoulder joint with the view of eradicating the disease.

In connection with the complete removal of the disease, Mr. Stiles, of Edinburgh, has introduced a method by which one may render visible even minute points of disease in a few minutes; and thus one can examine the surface of the mass removed before stitching up the wound, and ascertain whether the whole breast has been taken away, and whether any nodules of the disease have been cut across. The advantage of this method has been shown on several occasions, and has led to the discovery of nodules which would otherwise have been left behind. On removal of the breast the mass is thoroughly washed under a tap for five minutes, to remove the blood. It is then immersed for five minutes in a 5 per cent. solution of nitric acid, care being taken that the solution can come freely in contact with all parts of the surface. On removal from this solution it is again placed under the tap and thoroughly washed for five minutes. On inspecting the cut surface, the fat presents a dirty yellow colour, bands of fascia and fibrous tissue have a swollen, gelatinous, translucent appearance, and sections of acini, and more especially of nodules of disease (in fact, tissue containing numbers of cells), appear as white points.

Cysts in the breast.—I have already referred to the formation of cysts in fibro-adenomata, these cysts very often having intra-cystic growths, and also to the diffuse cystic disease of the breast following lobular mastitis. In some cases, however, one finds a cyst in the breast without any tumour in connection with it, and without any intra-cystic growth—a so-called **simple serous cyst** of the breast.

This condition of single cysts in the breast is also generally supposed to arise after localised mastitis, leading to active overgrowth of the epithelium, and at the same time to blocking of the ducts. These cysts of the breast generally occur in the substance of it. They form rounded, tense, hard tumours, in which it is seldom easy to get fluctuation, on account of the tenseness of the fluid. They are painless, and on attempting to move them the nipple becomes drawn upon, owing to the intimate connection of the cyst with the breast. They contain clear fluid. They may be single, or there may be two or three cysts present.

The *treatment* consists either in tapping and injecting the cyst in the same way as one treats a hydrocele, or in removing the cyst. As a rule, the condition will be cured by evacuating the contents of the cyst through a cannula, and injecting one or two minims of undiluted carbolic acid. The result is that the cyst wall becomes inflamed and fluid is effused, which, however, becomes absorbed in a few days, and the condition is cured. Where, however, there is any reason to suppose that the cyst is part of a tumour or small fibro-adenoma, or where the patient wants to be certainly cured, the simplest plan is to dissect it out. In some cases the cyst shells out with the greatest ease; in others it is embedded firmly in a mass of thickened breast tissue, and this must be taken away in order to effect a cure.

Galactocoele.—In connection with these single cysts of the breast I may also mention the condition known as galactocoele, by which is meant a cyst containing milk, which is, of course, more or less altered. These swellings are always formed during lactation, and the condition is due to dilatation of one of the larger ducts of the breast, with partial obstruction to the exit of the milk. That the obstruction is only partial is proved by the fact that, as a rule, pressure on a galactocoele leads to an outflow of milk from the nipple and partial emptying of the sac. In some cases these cysts also follow injury, and have been supposed to be due to rupture of a duct. These galactocoeles are innocent tumours. They form movable swellings, which are elastic, and if not too tense, fluctuating, and on pressure on them milk can generally be squeezed out from the nipple.

As regards the *treatment*, the best treatment is to excise them, but short of excision, tapping and injecting them with carbolic acid or with iodine may be employed. In these cases, however, the result is not nearly so certain as in the case of the ordinary serous cyst.

Involution cysts.—Lastly, we have involution cysts in the breast occurring after the menopause. These are small, generally multiple, cysts containing a glairy or serous fluid. They are generally associated with interstitial mastitis, and lie towards the surface of the gland. It is seldom that they necessitate any treatment; but if they do, tapping and injecting the larger ones with undiluted carbolic acid usually suffices.

LI. INJURIES AND DISEASES OF THE URINARY ORGANS.

By HENRY MORRIS, M.A., M.B. Lond., F.R.C.S.,

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INJURIES AND SURGICAL DISEASES OF THE KIDNEY.

Abnormalities of position of the kidney.—These may be grouped as (1) simple misplacements, (2) movable kidney, and (3) floating kidney.

(1) **Simple misplacements.**—In these the kidney may be higher or lower, nearer to or farther from the spine than usual, or may have its axes and borders altered in any direction, or may be turned over upon its anterior surface but yet thoroughly fixed in its position.

Among the congenital misplacements the most frequent is that known as the *horse-shoe kidney* (Fig. 872). This variety consists in fusion of the kidneys at their lower ends by means of a thick mass of renal or fibrous tissue, a transverse curve being thus formed with its con-

convexity almost invariably directed downwards, and over the front of which the ureters descend. The joined kidneys are lower down, and much nearer the spinal column than normal. Horse-shoe kidney has been found in nine out of 14,318 subjects examined.

In another set of congenital cases the kidney (usually the left)

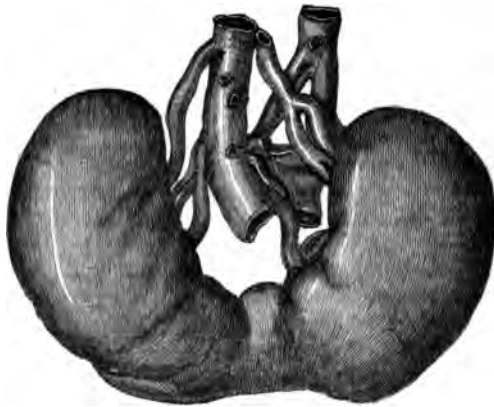


Fig. 872.—Horse-shoe Kidney, seen from behind. (Middlesex Hospital Museum.)

is placed over the sacro-iliac synchondrosis or the sacral promontory. Such malpositions in the case of women may cause dysmenorrhœa, and even serious obstruction to parturition.

Acquired misplacements are met with as the results of pressure or traction of tumours or surrounding organs.

It is quite exceptional for simple misplacement to need any *treatment*, but where it causes suffering to such an extent as to demand surgical interference, and cannot be fixed in such a position as not to cause pain, nephrectomy is the only available resource.

(2) **Movable kidney.**—The kidney, though more or less freely mobile, is excluded from the cavity of the peritoneum, occupying a position between that membrane in front and the muscular parietes behind. In the majority of cases the degree of mobility is but slight; occasionally, however, the peritoneum may be sufficiently loose to allow the kidney, moving behind it, to descend below the pelvic brim, or to pass as far forwards as the anterior abdominal parietes, or across to the opposite side of the spine. In some cases though the kidney moves freely it cannot be felt through the abdominal walls to do so. The movement occurs in the plane of the loins in the manner I have described as "*cinder sifting*."

Symptoms.—The subjective symptoms are a sensation of dragging and weight in the loin, severe paroxysms of pain resembling nephritic colic, a sense of something moving within the abdomen, vomiting more or less severe, flatulence, and other indications of gastric or intestinal disturbance. The symptoms are aggravated by exertion, and relieved by rest in the recumbent posture. Temporary jaundice is sometimes caused. The urine is healthy. I have drawn special attention to the cramp and agonising character of the pain in some cases of movable kidney.*

The physical signs, if any exist, are the presence of a more or less movable tumour of renal contour, which, on palpation, occasions pain or a peculiar sickening sensation. Occasionally there is no recess in the loin to indicate the place vacated by the kidney, although percussion of this part elicits more or less resonance. The respiratory movements as well as the position of the body influence the position of the kidney.

Diagnosis.—Tumours of the omentum or mesentery have been mistaken for movable kidney, as have also a distended gall bladder, enlargement of the head of the pancreas, and a small ovarian tumour. Hydronephrosis is an occasional result of movable kidney.

Treatment.—In many cases the symptoms are so trivial as to require no treatment. If only noticed after riding, dancing, or long standing, such exertion must be avoided.

A specially-fitted pad and belt should be worn to retain the kidney *in situ* should the mobility of the organ be the cause of continual pain and distress. Symptoms of congestion require absolute rest, hot fomentations, and anodynes. An operation is indicated

* *Brit. Med. Jour.*, vol. ii., 1889, p. 1083; also "*Surgical Diseases of Kidney*," p. 31.

where the symptoms are severe, unrelieved by rest or mechanical appliances, and when they occur in persons whose circumstances or temperament prevent the continued adoption of palliative measures.

When the movable organ is sound, or when both kidneys are movable, or when the non-movable kidney is diseased, nephrorraphy is the best operative measure. An incision is made in the loin over the kidney, and the organ is fixed by sutures to the fascia of the loin. Two or more sutures are required; and they should consist of some stout material, such as silk or kangaroo tendon. They should be passed well into the cortex of the organ, though some surgeons prefer to pierce the capsule of the kidney only. The results of this operation are usually very successful. A renal belt should be worn after convalescence.

When the movable kidney is extremely hydronephrotic nephrectomy is needed, provided that the other kidney is sound.

(3) **Floating kidney.**—This term designates that condition in which the peritoneum, owing to its congenital disposition, so completely envelops the kidney as to form a meso-nephron, and thus allows the organ to be moved in almost any direction. Floating kidney is of excessively rare occurrence. The treatment is based on the same principles as those indicated in the case of movable kidney.

Malformations of the kidney.—Congenital deviations from the natural form and size of the kidney are frequently the result of fusion of both organs, and, even when involving only one kidney, are generally accompanied by misplacements. Perhaps the commonest malformation is the so-called *congenital atrophy* of the kidney, in which one kidney is rudimentary. The next most common is the horse-shoe kidney already described (page 831).

One or both kidneys may exhibit a continuance of the foetal type in being *lobulated*. Sometimes the only malformation is at the pelvis of the kidney, *two pelves* being present, which may or may not communicate with each other. There may be *two ureters* to one kidney, and these may remain distinct as two tubes during the whole of their course, or may join together near the pelvis or bladder. The hilum of the kidney may be absent. The number of arteries going to the kidney is not infrequently increased; the origin of such abnormal renal arteries being very variable.

In some cases the deformity seems to have depended upon the relations of the blood-vessels immediately in contact with the misplaced organ.

Besides the horse-shoe form of *solitary kidney*, there is a variety of malformation in which the two organs are joined and form a disc-like kidney lying in the middle line, provided with a double or single pelvis.

Injuries of the kidney. Subparietal injuries.—These are by far the most common, and in them no open wound communicates with the injured organ.

The kidney is not unfrequently *ruptured* by direct blows on the
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abdomen and loin, or by falls from a height, without any injury happening to the parietes. The degree of laceration varies.

Blood is usually extravasated in considerable quantity into the circumrenal cellular tissue, and hæmorrhage may occur around the kidney or into its pelvis when there is no laceration whatever of the renal substance. In some cases the ureter, as well as the pelvis of the kidney, may be so completely plugged by extravasated blood as permanently to occlude the channel from the kidney to the bladder. When complete rupture is associated with laceration of the peritoneum, the hæmorrhage may be so copious as to prove suddenly fatal. On the other hand, the kidney may well-nigh be converted into a pulp without any extravasation of blood into the surrounding tissues. A partial laceration of the pelvis or ureter may be followed by adhesive inflammation and obliteration of the urinary duct.

Symptoms.—Hæmaturia following an injury to the loin is not necessarily symptomatic of ruptured or lacerated kidney; and, on the other hand, serious lesion of the organ may occur without giving rise to hæmaturia. The earliest symptom in many cases of sub-*parietal* injury is pain in the renal area, shooting down perhaps to the testicle or thigh. There may be frequent and painful micturition, the urine voided being highly mixed with blood. There may, on the other hand, be complete suppression of urine—a symptom suggestive of injury to both kidneys, attended by plugging of the renal vessels. Swelling of the belly has in certain instances come on rapidly, and been attended with fluctuation. If the injury has been inflicted from the front of the body, signs of traumatic peritonitis may set in.

When there is an absence of blood in the urine, injury to the kidney must nevertheless be suspected if there are pains in the renal region, collapse, or the appearances of internal hæmorrhage, with fulness and dulness of the injured loin, and rigidity of the corresponding abdominal muscles.

Though unfavourable, the *prognosis*, in cases of rupture of the kidney, its pelvis, or ureter, is not so grave as that in rupture of other abdominal organs. Death may be due to collapse, hæmorrhage, or peritonitis; or, later, to pyæmia, cystitis, or exhaustion from abscesses. The two chief conditions upon which recovery depends are the escape of the peritoneum, and of the large branches of the renal artery and vein.

Treatment.—Absolute rest in bed; subcutaneous injections of anodynes to relieve pain; half-drachm doses of liquid extract of ergot every two or three hours to check hæmorrhage; sucking of ice to relieve thirst. Strapping the affected side will sometimes ease pain considerably. The bowels, if full of solid *fecal* matter, may be evacuated by enemata, otherwise the less they are disturbed the better. The quantity of fluids taken into the stomach should be limited as much as possible. If sickness is present it is very important to check it as soon as possible by appropriate remedies.

If there is reason to think that hæmorrhage is going on, ice bags or Leiter's tubes should be applied to the loin and ilio-costal area of

the abdomen, but if hæmorrhage threatens life, despite all previous efforts to check it, an exploratory incision into the loin, followed, if necessary, by nephrectomy, should be practised. If clots accumulate in the bladder, or are forced on into the urethra, and give rise to much pain and distress, median or lateral urethrotomy should be performed.

Penetrating wounds of the kidney.—These may be inflicted upon the posterior surface only, in which case they do not involve the peritoneum; but when they affect the front surface they not only implicate the peritoneum, but very probably some of the other viscera as well.

Symptoms.—Severe pain in the renal region, occurring immediately upon the reception of the injury, and frequently extending along the ureter to the testicle, and even to the thigh. Hæmaturia may or may not be an early symptom. If the wound in the kidney is deep, blood and urine may escape from the external opening, or be extravasated into the retro-peritoneal tissue, or into the peritoneal cavity. Frequent and urgent but abortive attempts at micturition may be a prominent sign. Nausea, vomiting, rigidity of the parietes on the side injured, a feeble pulse increasing in rapidity, anxious countenance, and other indications of loss of blood are among the symptoms. If urinary extravasation invades a wounded peritoneum, peritonitis will soon show itself. In gunshot wounds, inflammation, more or less widespread, is inevitable; in punctured or incised wounds it may be escaped. Rigors indicate the occurrence of suppuration; pus in the urine, due to pyelitis, is frequently noticed in cases of gunshot wounds.

If a wound in the renal region is followed by the passage per urethram of bloody urine or pure blood, the *diagnosis* is pretty conclusive. If such a wound is followed by dysuria, or retention of urine, there is good reason to diagnose a wound of the organ with plugging of ureter with blood clot. Hæmaturia, followed by peritonitis, or the escape of urine through an external wound, leaves no doubt as to the nature of the injury.

Prognosis.—Incised wounds may heal rapidly, and without suppuration, whereas gunshot wounds are followed by more or less sloughing and suppuration, and all the risks to which these processes expose the patient.

The sources of danger from penetrating renal wounds are:—(1) Hæmorrhage, if the great vessels of the organ are wounded; (2) peritonitis, if the front surface of the organ or any of the adjacent viscera are penetrated; and (3) perinephritis, perinephric abscess, and effusions of blood, or blood and urine, behind the peritoneum. If the wound be inflicted upon the posterior surface, and neither peritoneum nor the great vessels of the hilum are wounded, recovery may be expected. An unfavourable prognosis must be given (a) when there is much extravasation, (b) if a foreign body remains in the wound, or (c) if the peritoneum has been torn.

Treatment.—If the patient is plethoric, and has not lost much

blood in the first instance, the application of numerous leeches to the loin or side of the abdomen will be of service should fever or traumatic peritonitis occur. Any foreign body which may have been carried into the wound must be carefully searched for with the probe or finger; and, if necessary, the wound should be enlarged for its removal. Complete rest; small quantities of milk, and barley-water or linseed tea; opium to relieve pain and muscular spasm; and ice or hot water, to allay vomiting, are the points in the treatment during the first week or two after a wound of the kidney.

If the large bowel is loaded, mild purgatives and emollient enemata are indicated; but after it has been once freed of its contents, the quieter it is kept the better.

The wound should be left open for drainage, unless it be a very large incised lesion, when one or more deep sutures may be introduced to bring the edges together in part of their extent.

A drainage-tube and a piece of perforated lint soaked in carbolised oil, and over this a layer of absorbent cotton wool, are the only dressings needed for these wounds. If at a later period phlegmonous inflammation or extravasation occurs, or if a circumscribed collection of urine or blood is formed, free incisions are most important. Hæmorrhage should be treated on the principles already described, as indicated in the case of subparietal injury. The importance of removing clots of blood from the bladder, if not passed naturally, cannot be too fully emphasised.

Prolapse of the kidney (injured or uninjured) through an external wound.—The prolapse may take place primarily—that is, at the time of the infliction of the parietal wound; or secondarily—that is, some time after the infliction of the wound, as the consequence of coughing, sneezing, or some other considerable muscular effort.

If the protruding kidney is not severely contused or completely broken up, and if the source of the hæmorrhage is not a branch of the renal artery or vein, and the bleeding can be controlled without securing either of these trunks, the organ ought to be replaced, especially if the patient be a young person of good constitution.

Perinephric extravasations. Air.—Air is occasionally found in considerable quantity around the kidney either associated or not with injury to that organ. The source of the air is not always traceable. In one case it appeared to have gained admission through a perineal incision which had been made on account of a rupture of the urethra, which complicated a fracture of the pelvis. Wounds of the loin, groin, and perinæum, whether complicated by wounds of the bowel or not, and fractures of the lower ribs, with injury to the lung, may be the causes of this form of extravasation. Retro-peritoneal abscess opening into the bowel may give rise to it.

Blood may be effused around the kidney from a ruptured artery or vein, or capillaries, as a result of violence. The clots so formed may ultimately break down and lead to suppuration. Fractures of the pelvis or lumbar vertebrae, ruptures of muscles, and the bursting

of an aneurysm of the abdominal aorta, have been the causes of considerable circumrenal hæmorrhage. The kidney may be raised so completely by the extravasated blood as to present a tumour anteriorly in the hypochondrium.

The *symptoms* vary with the cause and extent of the extravasation. When the blood occupies the cellular tissue of one loin, chiefly or entirely, it causes a tumour, sometimes difficult to diagnose from a distended kidney. If the source of the bleeding is a superficial laceration of the kidney, or a rupture of an artery (say one of the lumbar arteries), some weeks may elapse before the effusion is sufficient to give rise to any swelling or increased dulness in the loin, and no sign of faintness is noticed at any time; then, after some time longer, the effused blood becomes more solid, and the tumour more irregular, and by degrees perhaps it is absorbed. On the other hand, the blood and clot may disintegrate, in which circumstances the symptoms of suppuration will arise.

Recovery may take place after very extensive traumatic hæmorrhage; but retro-peritoneal hæmorrhages due to ruptured aneurysm are almost certainly fatal, though, it may be, tardily so.

If the hæmorrhage increases, or suppuration occurs, and surgical aid is not brought to bear upon the case, death may occur from peritonitis, due to tension upon, or rupture of, the peritoneum; or the colon may be penetrated, and fæces and flatus enter the blood tumour, and give rise to decomposition, septic absorption, and death.

Treatment.—When hæmorrhage is due to aneurysm, little or nothing in the way of treatment will avail; when due to wound of the kidney the treatment must be based upon the principles stated when discussing injuries to the kidney (page 835).

Urine is extravasated into the loin behind the peritoneum from a ruptured kidney, or from a direct penetrating wound, the result of operation or accident, or as a consequence of ulceration. Ulceration of the ureter, due to injury or the pressure of a tumour, may cause urinary extravasation into the loin or iliac region. The inflammation of the cellular tissue, resulting from urinary infiltration, may run on to suppuration, giving rise to a lumbar or inguinal abscess. If the quantity of urine effused is small, the cellulitis, stopping short of suppuration, may become chronic, spreading towards the iliac fossa, and causing contraction of the ilio-psoas muscle. In some instances the effused urine becomes encapsuled within a thick-walled cyst of inflammatory origin, with the cavity of which the kidney communicates at the point of rupture or ulceration. Sometimes phosphates accumulate in the space or cavity occupied by the effusion to such an extent as to block the drainage-tubes used in treating this extravasation by lumbar incision.

Treatment.—When the diagnosis is uncertain, but from the fulness and dulness of the loin there is reason to think that urine is escaping behind the peritoneum, an aspirating needle may clear up the diagnosis. In cases where the effusion again and again re-forms after paracentesis of the loin, a lumbar incision and drainage are

needed. Suppuration must be dealt with by early free incision. If the kidney is greatly damaged, nephrectomy will be requisite.

Perinephritis and perinephric abscess.—Perinephritis is inflammation of the cellular and adipose tissue surrounding the kidney. It may occur at any age, having been met with in quite young children.

Perinephric abscess is applied alike to all forms of pus formation in these tissues. It is rare before puberty.

Perinephric abscesses are :

(1) *Primary extrarenal abscesses*, or those which are independent of any fistulous opening into, or other disease of, the kidney. These may depend upon injuries, chills, etc., or may follow the acute exanthemata ; or the abscess may have extended from a distant part, as the spine, pelvis, appendix cæci, cæcum, testis, gall bladder, etc.

(2) *Consecutive extrarenal abscesses* : in which inflammation of the kidney has spread to the cellulo-adipose tissue (*a*) by contiguity, but without urinary infiltration ; or (*b*) as a result of a fistula communicating between the renal cavity, or substance, and the surrounding cellulo-adipose tissue. This form is usually due to suppurative pyelitis, or to tubercle, cancer, hydatid or other form of cystic disease, or to calculus of the kidney.

Symptoms.—These vary with the cause and acuteness of the disease. When the inflammation is secondary to some distant disease, such as pelvic cellulitis, the symptoms of the primary affection may disguise those of the perinephritis.

The constitutional indications of pus in the circumrenal connective tissue are the same as those excited by deep-seated suppuration elsewhere. The febrile temperature in some cases runs continuously high ; in others it is intermittent, and suggestive of malaria or pyæmia. Obstinate constipation is almost invariable.

Of the local symptoms, those due to pressure are more marked in perinephric abscess than in perinephritis. Pain, deep-seated and often paroxysmal, ushers in the disease ; sometimes dull and aching, at others darting, it courses along the distribution of the lumbar plexus. The pain is greatly intensified by bimanual compression of the loins.

The affected side will impart a sense of increased resistance and weight long before pus has formed, or the abscess is large enough to alter in any way the contour of the part. The skin in the loin is often waxy and œdematous. Fluctuation is frequently very remote, owing to the thickness of the parietes ; and in one case six pints of pus were pent up, but, on account of the great depth of the subcutaneous fat, no fluctuation could be detected. Œdema of the foot and ankle has preceded for many weeks every other sign of perinephric abscess. A peculiar lameness is often an early symptom due to the flexed position in which the thigh of the affected side is retained to relieve tension on the psoas muscle. When the tissue about the upper end of the kidney is affected, inflammation may spread to the under surface of the diaphragm and cause symptoms that have been mistaken for pleuro-pneumonia.

Perinephritis without suppuration.—The spinal column is preternaturally stiff, and the body in walking is inclined over to the affected side. Stooping is difficult. In the recumbent posture the patient will not extend the corresponding thigh beyond 160° , or in severe cases 130° . There is sometimes pain in the knee. These conditions together cause the case to resemble the second stage of hip disease, especially when the thigh is rotated outwards, so that the heel of the affected side during standing rests on the dorsum of the opposite foot. In perinephritis there is no tumefaction to be felt in the loin, as in perinephric abscess.

Prognosis.—In a few cases perinephritis ends in resolution before the suppurating stage has been reached. When suppuration occurs the prognosis depends chiefly on two things: the early and free evacuation of the pus, and the cause of the disease.

When the abscess is primary—i.e. not dependent upon renal or other visceral or spinal disease—an opening into it is soon followed by convalescence. If the abscess burst into the peritoneum, rapidly fatal peritonitis is extremely probable.

Diagnosis.—The affections that may be mistaken for perinephritis or perinephric abscess are lumbago, various organic diseases of the kidney, spinal caries, splenic tumours, fæcal accumulations in the colon, pleuro-pneumonia, morbus coxæ, and psoas abscess.

The higher situation of the pain; the tenderness in the loin; the fact that passive flexion is painless in itself; the free and painless mobility of the partially flexed thigh; the absence of tenderness and fulness over the upper end of the femur; absence of pain on percussion of the thigh; and the slight rigidity, if any, of the adductors and rotators, serve to distinguish perinephritis from hip disease.

The symptoms of perinephritis are very closely allied in many points to those which accompany perityphlitis (page 625); but the characteristic feature of perinephritis is, that the pain, tenderness, and swelling are first observed and most pronounced in the ilio-costal interspace behind, whereas in perityphlitis they are located in the iliac fossa and in front.

Treatment.—Primary perinephritis may be sometimes checked in its early stages by local depletion, hot baths, and poultices. In subacute or chronic inflammation, absorbent ointments containing lead or potassium iodides are useful. The bowels must be opened at the onset by a brisk purgative, and kept moderately active. Pain is relieved by morphia. The diet should consist of beef-tea, milk, light puddings, and such like. Directly the presence of pus is suspected it should be searched for by an exploratory incision, and if detected should be let out through a free opening in the loin. The abscess should then be washed out with a solution of iodine or carbolic lotion, and a drainage-tube inserted. The subsequent treatment must be conducted on general principles. Consecutive abscesses may have to be opened, and some of the less acute forms of primary abscess must not be allowed to close too early.

Abscess of the kidney.—This occurs as a consequence of the coalescence of a large number of miliary abscesses. Metastatic and secondary abscesses of large size may be due to obstruction of large vessels by emboli. Stricture or other disease of the lower urinary organs may also give rise to a circumscribed abscess in the tubular substance of the kidney. Other occasional causes are blows, wounds, and kicks. Renal calculus is one of the most common causes of large renal abscess. Circumscribed abscess usually affects only one kidney, and in a large number of cases the whole organ, including the pelvis, is involved.

Symptoms.—The constitutional symptoms are those which are ordinarily significant of the formation of pus. Hæmaturia often precedes abscess when the cause is traumatic. The absence of pus in the urine is no criterion, because in many cases there has been none detected throughout. If, however, the abscess has broken into the renal pelvis or ureter, the urine may abound in pus. If a tumour has formed in the loin, the discharge of pus by the bladder will probably be followed by a subsidence of the swelling. In the acute cases a fatal termination may occur within three weeks or less. Possibly, recovery may ensue, the contents of the abscess becoming inspissated and remaining quiescent for the rest of life.

Treatment.—If the cause be external violence, rest, anodynes, depletion, or the application of an ice-bag constitute the principles of treatment of inflammation in the early stages. After the first day or two of the inflammation hot fomentations must be continuously applied. If there is clear indication of a renal abscess, the pus ought to be evacuated through an incision in the loin. If, when the kidney is exposed, pus is found, it is not sufficient to evacuate it with a trochar and cannula. A free incision having been made into the abscess, the cavity should be emptied and its walls treated by the inunction of iodoform paste. If, however, the kidney should be found much destroyed, it would be better to remove it.

Traumatic nephritis. *Causes.*—Wound or contusion of the substance of the kidney; violent muscular strain; the presence of a calculus or of parasites. When blood has been extravasated into the cavity of the kidney, and the urine retained there in consequence of impaction of a blood clot in the ureter, pyelitis and pyelo-nephritis may arise.

Symptoms.—Rigors; fever; pain not constant, and very variable in degree, deep-seated and referable to the loin, sometimes diffused over a considerable area of the abdomen, and rarely of a throbbing character unless the perinephric tissue be also involved. Nearly all movements aggravate the pain. If the inflammation sets in soon after an injury, the urine always contains a trace of blood. Subsequently, in a few cases, pus may be found in the urine.

There is a disposition to the formation of gravel and calculus, and, as a consequence, to renal colic, after wounds or concussions of the kidney.

Traumatic nephritis is not usually serious, provided the damage

inflicted on the kidney is not great and the large vessels are not ruptured. If severe, the kidney may be softened down into a mere pulp.

Treatment.—If the kidney has been penetrated, urine may drain away by the external wound. If the organ has been opened by sub-
parietal laceration or rupture, the chief danger, when the large vessels are uninjured, is from infiltration of urine into the cellular tissue. Then it may be necessary to lay open the loin by a free incision down to the injured kidney, so as to provide for the free drainage of the extravasated urine and inflammatory products. If the kidney is completely destroyed by the inflammatory process, nephrectomy is indicated.

When there is no extravasation, small quantities of fluid diet, the application of cold or leeches, relief of the bowel by one good purgative or enema, and opium cautiously given to relieve pain, constitute the usual necessary details of treatment.

Renal fistulæ.—Fistulæ that communicate with the kidney and pelvis of the kidney.

Causes.—Renal fistulæ are caused, in the great majority of cases, by calculi in the pelvis of the kidney or in the ureter. Other causes are gunshot, punctured, or incised wounds, injuries inflicted by surgical operation, and abscess of the kidney. The opening into the cavity of the kidney or ureter is usually single and connected with the posterior aspect of the organ. Renal fistulæ may open at the loin or groin into the colon or duodenum, into the pleural cavity or lung, or into the peritoneum. It is comparatively rare for a fistula to open into the peritoneum. If the fistula result from a wound or a ruptured hydronephrotic cyst, urine, sometimes in large quantity, will escape from it; if from pyonephrosis due to ureteral obstruction, pus will be mingled with the urine; if from the conversion of the kidney into a tuberculous abscess cavity, the discharge will be puriform.

Renal fistulæ that open in the loin.—When a fluid of a urinous character escapes from a fistula that followed an attack of nephritis or injury to the kidney, the diagnosis as to the renal origin of the fistula is certain. It must be remembered, however, that a lumbar fistula, instead of communicating with the kidney at all, may be the result of disease in the lower urinary passages—i.e. in the ureter, bladder, or even the urethra.

Treatment.—The parts around the orifice must be kept clean and free from irritation. If, after a fair length of time has been allowed for spontaneous closure, the fistula persist, caustics, the hot iron, or an incision, so as to lay open or excise any sinuous track, remove callous edges, or spongy granulations, or calculous deposits, must be tried. The injection of iodine solution will sometimes stimulate the sinus to healthy action.

If the other kidney be sound, and a permanent fistula communicating with a diseased organ, threatening the life and sacrificing the comfort of the patient, resist other treatment, the best plan is to perform nephrectomy.

Renal fistulæ opening into the stomach.—These are of extremely rare occurrence. In one case of communication of the left kidney with the stomach, pus, urine, and calculi are said to have been vomited; but there is a considerable degree of uncertainty as to the genuineness of the symptoms and accuracy of diagnosis. In a case of gastro-renal fistula due to scrofulous pyelo-nephritis, admitted under the writer into the Middlesex Hospital in 1884, there was a history of "inflammation of the bladder" and of "pus in the motions," as well as in the urine. There were four sinuses in the back discharging pus. Careful examination of the chest and abdomen disclosed nothing. No physical signs of pelvic cellulitis or circum-renal abscess could be made out. Complete anuria preceded death. On post-mortem examination the only communication between the kidney and the gastro-intestinal tract was a fistula of the diameter of a crowquill, opening into the left margin of the great curvature of the stomach.

Renal fistulæ communicating with different parts of the intestine, and renal fistulæ opening into the lung, are of very rare occurrence. Prompt surgical treatment might in some instances have prevented their occurrence.

Ureteral fistulæ are almost invariably the results of operation wounds.

Hydronephrosis.—This term is given to over-distension of the kidney with urine, the result of mechanical obstruction, no matter whether the cause be in the urethra, bladder, or ureter. Probably one-third of the cases of hydronephrosis in which a palpable tumour is formed have a congenital origin.

Congenital causes.—Twists, undue obliquity, contractions, and other anomalies of the ureter. This duct is in some cases converted into a fibrous cord, in which condition the hydronephrosis exists at birth; or its vesical orifice may be merely of pin-hole size; or minute cysts may be developed in its mucous membrane; or the angle of its junction with the kidney may be so acute as to render the descent of the urine difficult. Abnormal relation of renal vessels may press on the ureter and cause renal distension.

The congenital causes do not always give rise to hydronephrosis in infancy or in very young life. There are several cases on record which show that a congenital cause has acted very slowly and incompletely, if at all, for a long time; but that after some years a hydronephrotic tumour has been formed and terminated fatally.

The **acquired causes** of hydronephrosis are numerous, and may be situated in, behind, or in front of the bladder.

Causes acting behind the bladder:—

- (a) Cancer and other tumours of the pelvis, including some conditions of the pregnant uterus.
- (b) Calculus, either by its impaction in the ureter, or by the ulceration and subsequent contraction excited at some spot in this tube, during its passage to the bladder.
- (c) Contraction of the ureter following an injury.

- (d) The obstruction caused by the kinking of the ureter of a movable kind.
- (e) The contraction of the pelvic cellular tissue following inflammation or suppuration.

Causes acting within the bladder :—

- (a) Inflammation and abscess of the bladder.
- (b) Tumours of the bladder—such as papilloma.
- (c) Calculus of the bladder.

Causes acting in front of the bladder :—

- (a) Enlarged prostate.
- (b) Stricture of the urethra.
- (c) Narrow meatus or tight foreskin.

Hydronephrosis may affect both kidneys, or only one, or may be limited to only a part of one kidney. Cases of double hydronephrosis are commonly of congenital origin. The proportion of cases in which hydronephrosis produces a palpable abdominal tumour is very small compared with the frequency of the existence of the disease.

Pathology.—The pelvis of the kidney first becomes converted into a spheroidal sac, then the calyces are widened and stretched in every direction, and at length the capsule of the organ is expanded, and what remains of its cortical and medullary substance becomes still further compressed and absorbed until nothing is left but a loculated cyst (Fig. 873). The size of the hydronephrotic sac may not exceed that of a normal kidney, it may even be smaller; or, on the other hand, it may be sufficiently large to form a swelling occupying a great part of the abdominal cavity. The contained fluid is only water holding a larger amount of sodium chloride than exists in urine, and a few epithelium cells. Its quantity is sometimes enormous, reaching several gallons. Hydronephrotic kidneys, however, differ very much from one another; in some cases the renal substance atrophies more or less completely, and the fibrous envelope enlarges so that nothing but a sac of fibrous tissue remains; in other cases the expansion of the interior of the organ is little

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Fig. 873.—Unilateral (intermittent) Hydronephrosis. The ureter at the point where it left the renal sinus had a diameter of 8 cm. (Bland Sutton; "Tumours.")

marked compared with the enormous thickening of the cortex of the kidney.

Symptoms.—Hydronephrosis may occur at any age, and is twice as frequent in females as in males. When the dilatation is insufficient to give rise to a tumour, there are generally no symptoms characteristic of hydronephrosis. Out of a series of 142 Middlesex Hospital cases, an abdominal tumour was formed in but very few. In some advanced cases in which no tumour exists, there are thirst, pain in the back, frequent micturition, partial, total, or intermittent anuria, and either obscure or agonising abdominal pains.

A hydronephrotic tumour is dull on percussion, sometimes lobate in contour, and frequently fluctuates. It has all the characters of a renal tumour, being situated in the flank, pressing backwards and outwards the ilio-costal parietes, having the colon in front of it, and the small intestine either in front or thrust over to the opposite side of the abdomen, according to the bulk of the swelling. If of no great size, it may be painless; if large, it may give rise to excruciating suffering.*

When it arises from some innocent cause, as pregnancy or uterine flexion, its development is unattended by any constitutional or local disturbance; but when from some painful cause, such as a movable kidney or an impacted calculus, the symptoms incidental to this particular condition will occur before the tumour makes its appearance.

There are instances of the tumour *intermitting*, i.e. being prominent at one time and not distinguishable at another. In such cases the disappearance of the tumour is characterised by the passage of an increased amount of urine per urethram.

Diagnosis.—When of moderate size, it has to be distinguished from renal, or perinephric abscess, and perinephric extravasation. When it forms a palpable tumour, it may be mistaken for pyonephrosis, or for a hydatid or serous cyst of the kidney, liver, or spleen. When of great size it may simulate ascites or ovarian dropsy. If the subsidence of the tumour is followed by an increase in the outflow of urine, the diagnosis as to its hydronephrotic nature is well nigh certain. Perinephric abscess is quicker in its course, and excites much more pain and constitutional trouble in its early stage. Between hydronephrotic and pyonephrotic tumours the diagnosis is often impossible.

Purulent urine, rigors, and fever indicate pyonephrosis as a rule, but such diagnostic symptoms may be absent. Hydatid and serous cysts of the kidneys are best diagnosed by their history.

From ovarian tumours the diagnosis is often very difficult. These are, as a rule, more mobile than renal cysts, and enlarge upwards from the pelvis, not forwards from the loin. Moreover, the intestines are behind an ovarian and in front of a renal tumour. When the tumour is renal the uterus is neither displaced nor fixed.

* "Surgical Diseases of Kidney," pp. 311, 312.

Prognosis.—This in great measure depends upon the distension, but chiefly upon whether one or both organs are involved. If only one kidney is affected, and the tumour not large, life may be indefinitely prolonged. If the distension increases, death will result from pressure on neighbouring organs, rupture into the peritoneum, or from suppression of urine and uræmia.

Treatment.—Medical remedies are of no avail. When of small size and painless, these hydronephrotic tumours may be left alone. When they cause trouble, owing to pressure, they have been aspirated, and occasionally with success, after one or several tapplings. *Friction* of the tumour has proved successful in overcoming the obstacle to the passage of the urine, but is not free of danger and cannot be relied upon. If paracentesis is decided upon, the puncture should be made half-way between the last rib and the iliac crest, and two inches behind the anterior superior spine of the ilium. Repeated tapplings will probably be required.

In most cases the operation of *nephrotomy* should be undertaken. The kidney is cut down upon by an incision through the loin, and the hydronephrotic sac opened and emptied of its contents. The edges of the cut sac are then brought into contact with the skin and fastened there by sutures, and the sac is drained by a good-sized drainage-tube.

Nephrectomy is the proper treatment for hydronephrosis attended with great destruction of the kidney, and especially when due to a permanent cause. It is remarkable with what ease and through how small an opening a very large hydronephrotic cyst can be peeled out from its connections after evacuating the contents—if only care is taken to cut down upon the sac itself before the enucleation is commenced. When a fistula remains in the loin after nephrotomy, and the character of the fluid is very purulent and offensive, the patient runs risks from the continuance of such a sinus, and cannot derive any benefit from retaining such a useless remnant of a kidney. Lumbar nephrectomy should in such a case be performed.

Congenital hydronephrosis.—By congenital hydronephrosis is meant hydronephrosis of the fœtus and new-born; not hydro-nephrosis which occurs some time after birth and is due to a congenital cause.

In by far the larger number of cases of hydronephrosis found in the fœtus and new-born, both kidneys are involved, the most common cause being imperforate urethra. It may be due to minute cysts, or membranous septa in the urethra, or to cysts in the ureter or pelvis of the kidney. The subjects of this disease may be born dead, or may live for a few weeks, months, or even years.

The urine removed from some of the cases of congenital hydronephrosis has contained little or no urea. The size of a hydronephrotic fœtus has proved a serious impediment to labour in several cases, and has rendered parturition impossible, until the abdomen of the child has been reduced by tapping.

Congenital hydronephrosis is frequently associated with some other congenital deformity, such as hare-lip and club foot. It proves that the secretion of urine goes on to a very considerable extent during the latter half of intra-uterine gestation; and that when any obstacle to the outflow of urine exists, the same pernicious effects of distension of the ureters and kidneys occur before birth as are commonly known to arise from urethral stricture, calculus, and other causes of obstruction after birth.

Pyonephrosis.—This term implies dilatation of the pelvis and calyces of the kidney, with pus, or pus and urine. In advanced cases the dilatation and suppuration extend beyond the calyces, and go on to compression and disintegration of the medullary and cortical substance, converting the organ into a large loculated sac, the nature of whose contents depends on the cause of the obstruction (Fig. 874).

Causes.—Hydronephrosis becomes pyonephrosis as soon as suppuration occurs; and, therefore, the causes which produce pyonephrosis are similar to those which lead to hydronephrosis. When an obstruction causes pyonephrosis at once, it is more complete in its character, and more rapid in its irritative effects upon the kidney, than when it causes hydronephrosis first. In some cases of pyonephrosis the pyelitis, instead of following, has preceded the obstruction. As a result of pyelitis, a clot of blood, or a little mass of inspissated pus; or, again, a fragment of diphtheritic, cancerous, tuberculous, or semi-organised false membrane, may block the ureter.

Symptoms.—In the early stages the symptoms are those excited by the causes of obstruction, whatever they may be; and in addition those of pyelitis.

If the obstruction be not complete, there will be pus in the urine; if intermittent, there will be intervals during which no pus is discharged; if complete and permanent, there will be an entire absence of pus in the urine. There will be constitutional symptoms of suppuration and, when the pyelitis is very chronic, all the characters of hectic. When a tumour forms in either loin, its characters are similar to those of hydronephrosis, already described (page 844). The urine should be repeatedly examined and its varying quantity and constituents carefully noted.

Diagnosis.—The tumours which may be mistaken for pyonephrosis are those resulting from morbid enlargement of the spleen, gall bladder, hydronephrosis, and other renal tumours, hydatids, abscesses, and ruptured aortic aneurysms. Pyonephrosis is usually characterised by febrile symptoms; the pain of the tumour is increased by pressure over it, and by movements of the trunk; and when the ureter is not actually occluded, there is more or less pus in the urine. Not only should the nature of the tumours be ascertained, but the urethra, prostate, and bladder should be carefully examined, with the view of diagnosing the cause of obstruction.

Prognosis.—In many instances of pyonephrosis the prognosis is unfavourable, and is determined by the nature of the cause. When pyonephrosis, of one side only, is produced in persons with

previously healthy kidneys, by some cause which occludes the ureter and does not interfere with the opposite kidney, the prognosis, as regards life, at least, is good, if early relief to the pent-up urine and pus be given.

Treatment, in the early stages, consists in the removal, if possible, of the cause of obstruction and distension, and the improvement of the pyelitis.

Palliative treatment of the tumour is permissible where there is not complete obstruction, and the pus and urine can escape by the



Fig. 874.—Kidney in an advanced State of Calculous Pyonephrosis. (Middlesex Hospital Museum.)

ureter. In many instances, however, the proper treatment is nephrotomy, palliatives being useless and delay dangerous. *The circumstances that indicate nephrotomy* are: constant pain, increasing size of the tumour, continued fever, severe gastric and intestinal disturbance from pressure, inflammation and adhesion of surrounding structures and threatened ulceration and rupture of the tumour into them. The operation gives great and instant relief; and in individuals with fairly good constitutions it may be said to be quite free from danger. After opening the kidney the interior of the cyst should be examined with the finger and with the probe and sound, in order to ascertain the presence or not of a calculus in the pelvis or upper end of the ureter. This procedure should never be omitted.

If a permanent fistula result, and a considerable quantity of pus is daily discharged from it, especially if the matter discharged is very offensive, or when lardaceous disease threatens, lumbar *nephrectomy* should be performed. The results of lumbar nephrectomy for pyonephrosis are fairly good.

Hæmaturia. Sources of the hæmorrhage.—The blood contained in the urine may have its origin in any spot in the urinary apparatus. When occurring as the result of an injury to, or well-marked disease of, one of the urinary organs, the signs indicative of the source of the bleeding will in many cases be unmistakable.

In those cases, however, in which blood is passed per urethram, and there is nothing in the history of the condition or surrounding circumstances to afford any information as to the source whence it is derived, the following considerations, though not absolutely conclusive, will nevertheless prove of considerable assistance in an endeavour to determine this point.

(1) If through the whole volume of urine that has been voided the blood is pretty uniformly diffused, the probability is that it comes primarily from the *kidney*.

(2) If the urine expelled is at first clear and normal in colour as it issues from the urethra, and becomes more and more deeply tinged with blood as micturition proceeds, till at length the residue of the voided fluid consists of almost pure, if not quite pure, blood, the source is most likely located in the *bladder*.

(3) If at the commencement of micturition a jet of more or less pure blood is expelled, and the urine, as it escapes, almost at once becomes clear and remains so to the last drop, the origin of the bleeding may be referred to the mucous membrane of the *urethra*. Blood may ooze from the urethra independently of micturition.

Causes of renal hæmaturia.—(1) Simple contusion of the kidney.

(2) Temporary congestion of the cavity of the kidney without any breach of surface.

(3) Hæmaturia of a temporary character may be caused by an embolism or thrombus within the kidney.

(4) Inflammation extended to an uninjured kidney from the muscular or circumrenal cellular tissue of the loin that has been damaged by injury.

(5) Slight hæmaturia has followed simple shaking of the kidney, as in horse exercise.

(6) Intermittent hæmaturia may result from Bright's disease, tuberculous disease, calculus, or uric acid diathesis. It may be vicarious.

(7) Hæmorrhage from the kidney may result from catheterism, especially in elderly men with prostatic disease who for a long time have but imperfectly emptied their bladder. It might happen to a young man of debilitated constitution after a fit of painful retention.

Symptoms of hæmorrhage from the kidney the result of catheterism

—The hæmaturia occurs after the withdrawal of the urine, no blood being noticed in the urine that is taken away the first time the catheter is used. On the second occasion the urine withdrawn will be from first to last mixed with blood to a greater or less extent, according to the degree of congestion, or the number and size of the vessels that have given way. Subsequently, each act of micturition, or each introduction of the catheter, for some days may be attended with the escape of blood mixed with the urine throughout. Sometimes no indication of mischief will be experienced until the blood is actually seen; in other cases the relief of retention by catheterism may be soon followed by pain referred to the neck of the bladder, a sense of weight in the hypogastrium, with a frequent desire to micturate. Perhaps it is the liability of the hæmorrhage to be followed by pyelitis and cystitis, rather than the actual loss of blood, that is the chief source of danger. If bleeding is very free, clots are formed either in the pelvis of the kidney or in the bladder. If in the kidney, the passage of clots along the ureter will excite symptoms resembling those of renal colic; if in the bladder, the symptoms will be referred to that organ or the urethra.

Diagnosis.—Urethral hæmorrhage is negatived because the blood from this source flows independently, or at the starting, of micturition.

Prostatic hæmorrhage can usually be excluded on the same ground. Vesical hæmorrhage is improbable, because, the bladder being a collapsing organ, the mucous surfaces fall together and receive some support from the surrounding viscera. That the hæmorrhage in such cases as we are considering comes from the congested vessels of the kidney, and is not due to cancer, calculus, tubercle, etc., the history and mode of onset of the bleeding will in most cases clearly show.

Prognosis.—This must always be serious in old men with prostatic trouble, or in young men who have a hæmorrhagic tendency. As has been before stated, pyelitis and cystitis constitute probable sources of danger. The bleeding may itself be a sign of great peril in enfeebled subjects.

Treatment.—To prevent the occurrence of hæmorrhage, great care should be taken before the first catheterism. The catheter should never be used, at least on a first occasion, upon a person while standing, or in any other than the recumbent posture, and the instrument should be of such a calibre (No. 6 or 7) as to prevent too rapid emptying of the bladder. Neither coughing nor straining on the part of the patient, nor hypogastric pressure by the surgeon's hand, should be permitted.

When hæmorrhage has commenced, no effort should be made to check it by applying ice externally. Warmth and rest in the horizontal position and restricted simple diet are indicated. Ergot of rye is the most useful of drugs, given in half-drachm doses of the liquid extract every few hours. Gallic acid in 10-grain doses does very well, as does also tincture of perchloride of iron. Opium quiets the nervous system and steadies the circulation.

If clots accumulate in the bladder they must be removed through a double-action catheter, and the bladder should be irrigated with warm water. If there is any difficulty in washing out the clots, and their presence has excited much vesical irritability, external urethrotomy, or lateral cystotomy, should be performed and the bladder freely drained.

Morphia suppositories relieve irritability of the bladder, and enemata should be employed to keep the rectum empty.

Renal calculus.—If the crystalline particles that are normally held in solution in the urine are deposited in excess, and happen to become cemented together by a fragment of mucus or blood clot, and are subsequently added to by fresh depositions from the urine, a calculus is constructed, which may either be discharged with the urine, causing more or less *renal colic* in its transit along the ureter, or may remain behind in one of the calyces, or in the pelvis of the kidney, there to grow by fresh accretions, until it attains a size altogether in excess of anything that can pass along the ureter. Calculi may originate in the uriniferous tubes, or in one of the calyces of the kidney.

Varieties.—The most common form of renal calculus is the uric acid, the next most common the oxalate of lime; but carbonate of lime, phosphate of lime, a mixture of phosphate and the ammonio-magnesian phosphate (the fusible calculus), cystine, xanthine, urate of ammonium, or the mixed urates, are occasionally, though rarely, found as the nuclei or chief constituents of renal stones. Alternating calculi of uric acid, oxalate of lime, and phosphates in distinct layers, are not uncommon. A drop of dried blood occasionally constitutes the nucleus. Renal calculi are formed at all periods of life, but they are of most common occurrence before the age of fifteen and after fifty.

The nucleus in the case of an infant is usually formed of ammonia urate, that in a person of young adult life consists of uric acid; whilst after the fortieth year oxalate of lime constitutes the nucleus. One or many calculi may be formed in the same kidney; when composed of lime oxalate, the calculus is usually single.

Conformation.—A renal calculus may be a small, round, smooth body, or a large, rough, branched mass filling all the pelvis and calyces. A stone as large as a marble, sharply mammillated on its surface, may remain confined to one of the calyces for years without giving rise to more change than induration of the whole organ, due to slight or chronic interstitial inflammation. On the other hand, quite a minute stone, not much, if any, larger than a mustard seed or grape seed, whilst in the tubular structure of the kidney, will excite congestion, and even acute inflammation and abscess.

Symptoms.—A small stone may develop, travel, and escape without giving rise to any symptom. A stone of large size may exist for years without causing any noticeable symptoms.

As a rule, there is at some time blood or albumen mixed with the urine, some lumbar pain or aching, some vesical irritability, and perhaps some pain in the testicle. If the stone has existed a long time, pus, mucus, or albumen will be found daily in a minute or moderate or marked quantity in the urine. Pain is a very prominent and marked symptom. It usually takes the form of aching lumbar pain, varied by exacerbations of an acute and spasmodic character, that is known as renal colic, and which is very characteristic of stone in the kidney. All forms of movement, such as walking or riding, are apt to bring on attacks of renal colic; but it may arise from a much slighter cause, such as merely turning in bed.

As soon as a stone enters the ureter, or is being propelled along it, renal colic sets in, the attack coming on suddenly, lasting a few hours, or two or three days, and suddenly subsiding, to recur at some future period if the stone, instead of escaping at the lower end of the ureter, is simply displaced from the upper orifice into some less important point in the renal pelvis. Recurring attacks of colic may arise

also from fresh formation of renal calculus. The paroxysmal pain shoots down the course of the branches of the lumbar plexus, and is felt in the bladder, groin, or thigh, if not in all these parts, and is intensified by the spasmodic contractions of the ureter.



Fig. 875.—Two Views of the same (Right) Kidney removed from a Woman who died of Cirrhosis of the Liver. A sarcomatous tumour, the size of a fist, is attached to the hilum and completely surrounds the pelvis and commencement of the ureter. The pelvis of the kidney is dilated and contains two rough, dark calculi, one of which is spherical and the other branched. (Middlesex Hospital Museum.)

Collapse and faintness are not uncommon; the bladder is irritable, and the urine blood-stained and loaded with urates. The attack is often ushered in with a rigor and generally accompanied by vomiting and profuse perspiration.

When the patient is very thin, and the stone large, it may sometimes be detected on palpation of the loin. The hæmaturia is not often profuse or constant; it is not proportionate to the size or number of the stones, though it may be remembered that oxalic calculi have the roughest and therefore the most irritating surface.

Pus in the urine is the consequence of inflammation of the pelvis and calyces of the kidney; mucous threads occur more frequently when the calculus is of oxalate of lime. Frequency of micturition is a symptom of great importance.

Diagnosis.—Probably the greatest difficulty in *diagnosis* is between early tuberculous kidney and renal calculus. When the frequency of micturition and slightly purulent urine are met with in a person of strumous habit, and are unaccompanied by a history of hæmaturia, the strumous nature of the disease is clear; but when they are associated with a history of hæmaturia, and sharp lumbar or testicular pain in an otherwise healthy-looking person, calculus is greatly more probable.

Renal calculus must be diagnosed from all the other causes of hæmaturia. Due attention to the clinical history and features of the case, the presence of renal colic, and the absence of any cause of hæmaturia in the bladder or urethra as evidenced by examination with the sound, will usually clear up the case. Small vesical papillomata may cause difficulty, as they sometimes excite very similar symptoms; but in these cases the lumbar symptoms of stone will be absent.

Treatment.—This may be prophylactic, palliative, and surgical.

(1) *Prophylaxis.*—Moderate amount of well-selected food; animal diet in moderation; and avoidance of an excess of nitrogenous food.

(2) *Palliative treatment.*—Free use of alkaline drinks or distilled water. Saline aperients. During an attack of renal colic, the hot bath; hot opium or belladonna fomentations; subcutaneous injections of morphia; suppositories of belladonna and morphia. Warm diluent drinks may be given, and the patient should lie with the shoulders and thighs raised.

(3) *Surgical treatment.*—When the symptoms of stone are severe, and are not removed or rendered bearable by several months of medicinal treatment and rest; when, in order to diminish pain or hæmaturia, the patient is compelled to confine himself to the recumbent posture; or when anuria supervenes upon the symptoms of calculus in one or both kidneys, *nephro-lithotomy* is indicated. The object of this operation is to save the kidney. If, however, the organ is in great part destroyed, if there is calculous pyelitis, or calculous hydronephrosis or pyonephrosis, the operation of *nephrotomy* or

incision and drainage of the disorganised organ should be performed. To nephro-lithotomy the surgeon should look as a means of preventing the disastrous pathological changes which follow a calculus that is aggressive in its course. In this operation the stone is removed, the wound in the kidney closed, and the kidney preserved from any further deterioration. Nephrotomy or nephrectomy should be employed as a means of saving life when the kidney is already so far destroyed as to exclude all hopes of saving it.

If, after the kidney has been thoroughly explored, not only with the finger, but by incision, and digital examination of the interior of the renal cavity, a stone cannot be detected, the renal wound should be closed by catgut sutures, when patients after such an exploration have not lost all their former symptoms.

Acute and subacute interstitial nephritis.—As a rule this condition affects both kidneys, though to an unequal extent. It consists in an inflammation of the intertubular connective tissue of the kidney.

Causes.—Although it may be brought on by any of the causes of obstruction enumerated under hydronephrosis (page 842), it is especially prone to occur if the kidney, previously subjected to undue pressure, is excited by reflex irritation, such as catheterism in a case of long-standing stricture or prostatic enlargement.

Symptoms.—When due to chronic obstruction the symptoms begin very insidiously and run an irregular course; but when excited by a surgical operation the disease generally commences by a distinct rigor.

As soon as the inflammation has set in the general health becomes much impaired.

The temperature rises two or three degrees at night, the skin is hot and pungent, and there is great thirst.

There is rarely, if ever, any tenderness on deep pressure about the kidney, and pain is seldom felt.

There is never more than a trace of albumen in the urine, but when cystitis, prostatitis, or urethritis exists, there may be a considerable admixture of pus or blood.

When the disease is going to terminate favourably the symptoms gradually disappear.

On the other hand, after the symptoms have lasted some time the patient dies from exhaustion, or more frequently from suppuration of the kidney.

The prognosis depends on the previously healthy or unhealthy condition of the kidney, and as to whether the primary cause of disease is removable or not. In cases in which the onset is attended with prolonged suppression of urine, a fatal issue may be expected.

Treatment.—The causes of obstruction to the passage of urine should as soon as possible be overcome, and retention obviated by catheterism. Stricture must be dilated or divided, perineal abscesses opened, or enlarged prostate appropriately dealt with.

All instrumentation must be as gentle as possible.

Decomposition of the urine in the bladder should be prevented by the evening and morning irrigation of the bladder with some antiseptic wash. Rest in bed ; hot dry bran or flannels to the loin, with dry or moist cupping ; bland nutrient food ; and the avoidance, or only very sparing use, of stimulants, constitute the principles of treatment. No medicines are of any special use.

Suppurative nephritis, pyelitis, and pyelo-nephritis.—

One of the most frequent of the secondary affections of the kidney (secondary, that is, to obstruction to the outflow of urine ; to reflex irritation ; or to decomposition of urine in the bladder) is suppuration in the pelvis (suppurative pyelitis), or in the substance of the kidney (suppurative nephritis), or in both (suppurative pyelo-nephritis).

In by far the greater number of such cases chronic dilatation of the pelvis and calyces precedes the suppuration—the latter taking the form of numerous small abscesses scattered throughout the renal substance. It is to this general affection of pelvis and substance of the kidney from obstruction in, or disease of, the lower urinary passages that the term suppurative pyelo-nephritis has been given. It is to this condition that the term *surgical kidney* has also, but very inaptly, been applied.

Suppurative nephritis, or, in other words, “acute interstitial nephritis, with scattered points of suppuration” (Beck), occasionally occurs alone without any affection of the ureter and pelvis of the kidney ; but much more commonly acute pyelitis and suppurative nephritis exist simultaneously.

Causes.—Stricture of the urethra ; prostatic enlargement ; vesical calculus ; palsy of the bladder ; congenital phimosis ; cancer ; blood coagula in the ureter, renal pelvis, or calyces ; and in the female, pregnancy and disease of the pelvic organs.

Symptoms.—When a patient who is the subject of retention or decomposition of the urine develops high fever, headache, somnolence, nausea, a dry, crusted, and fissured tongue, and an anxious, sallow face, and, in addition, emaciates rapidly, it is certain that pyelo-nephritis is present, and will in all probability prove fatal.

Sometimes the attack commences with a rigor ; the temperature reaches in some cases 106°.

The character of the urine varies in different cases.

Diagnosis.—Pyelo-nephritis or interstitial suppurative nephritis is to be distinguished from acute Bright’s disease by the absence of convulsions, of œdema, and of the harsh, dry skin which characterises the latter affection. The urine, instead of being scanty and of a reddish-brown colour, as in Bright’s disease, is abundant and purulent, and but slightly, if at all, tinged with blood.

Pyæmia is distinguished by the secondary abscesses ; tender, purulent swellings of the joints ; sweet, mawkish breath ; and jaundiced skin and offensive diarrhœa. From enteric fever the history and course of the disease, and absence of typhoid stools, will

usually constitute a sufficient distinction. Ague is not difficult to distinguish, but the diagnosis from uræmia is much more complex.

Prognosis.—This is very unfavourable, most patients dying within three or four weeks; sometimes death occurs in a few days. If, however, the fever be moderate, and the strength of the patient not exhausted, the removal of the cause of obstruction may be followed by recovery.

Treatment.—This is the same as that recommended for acute and subacute nephritis without suppuration. Quinine in full doses is sometimes efficacious in checking the rise of temperature.

Renal affections secondary to disease of, or operations upon, the lower urinary organs. (1) **Consequences to the kidney of disease of the lower urinary organs.**

- (a) Hydronephrosis with or without chronic inflammation of the renal substance.
- (b) Pyonephrosis, or dilatation with suppuration of the pelvis and calyces.
- (c) Acute and subacute interstitial nephritis.
- (d) Suppurative nephritis and pyelitis.
- (e) Cicatricial kidney, or one form of granular contracted kidney, the result of recovery from simple or suppurative interstitial nephritis.

(2) **Consequences to the kidney of surgical procedures on the lower urinary organs.**—The passage of an instrument along the urethra, or the performance of any operation upon it or the bladder, in some instances (especially if the kidneys are diseased), excites a febrile condition known by the names "*catheter*," "*urethral*," "*urinary*," and "*uræmic*" fever.

In urinary fever there is always either a functional and transitory or an organic lesion of the kidney. The varieties of this form of fever are therefore classified according to their effects upon the kidney.

(1) *Congestive urinary fever.*—This occurs in three forms: (a) single paroxysm, (b) recurring paroxysms, (c) intermittent paroxysms. (a) This variety is often functional—i.e. due to reflex irritation of the renal nerves. It is the least dangerous variety of urinary fever. The paroxysm is characterised by a rigor of variable intensity, followed by an elevation of temperature of one or two degrees, and accompanied by nausea and headache. The duration of the whole attack is usually only a few hours, after which the patient may feel in his usual health again. (b) The second form differs only in degree from the first. The paroxysms are more prolonged and recurrences take place. The attack usually lasts four or five days and complete recovery usually follows. (c) In the third form, which is very rare, the fever subsides, and then, after a period of perfect recovery, a fresh paroxysm occurs without any new exciting cause. Such intermittent paroxysms may extend over some weeks or even months.

(2) *Inflammatory urinary fever*, or fever due to acute interstitial nephritis.

(3) *Suppurative urinary fever*, or fever due to suppurative nephritis or pyelo-nephritis.

The last two varieties are much more serious in their course and prognosis than the first. Their symptoms have been already described.

In addition to urinary fever, *hæmorrhage from the kidney* sometimes results from the use of the catheter in cases of long-standing retention of urine (page 849); and *uræmia without fever* is an occasional consequence of catheterism. Interstitial nephritis and pyelo-nephritis, though they are the two severest and most fatal forms of fever that follow the use of surgical instruments, may nevertheless occur quite irrespectively of the use of instruments. The *congestive* forms of urinary fever may be excited by the simple introduction of the bougie or sound in a person with quite healthy kidneys.

The methods of production of secondary renal disease are :

(1) *Increased pressure* in the tubules from obstruction to the escape of urine

(2) *Reflex irritation* of the kidney.

(3) *Septic matter* in the pelvis of the kidney, and possibly in the lower part of the tubules.

As a rule, increased pressure when acting alone as the result of obstruction will produce hydronephrosis; reflex irritation will excite one of the transient or congestive types of urinary fever, and septic matter will cause acute or suppurative pyelo-nephritis.

Urine may undergo decomposition in the pelvis of the kidney in two ways, namely :

1. By direct extension of infective changes from the bladder along the ureter to the kidney; and

2. By infective changes originating within the pelvis of the kidney. Various conditions, besides an obstruction to the outflow of urine from the bladder (such as cancer of the pelvic organs, or the bursting of an abscess into the bladder) may excite cystitis, and thus lead to ammoniacal decomposition of the urine within the bladder. When pyelitis is provoked by the impaction of a renal calculus in the pelvis or ureter, or when it occurs in the course of any of the continued fevers, alkaline fermentation of the urine results through the agency of the muco-pus, which is secreted by the mucous membrane of the pelvis and calyces of the kidney.

Tuberculous kidney.—Two forms of tubercle of the kidney are met with, namely :—

1. Disseminated tuberculosis, and

2. Tuberculous pyelitis or pyelo-nephritis.

The first of these diseases is more common in children; the second form often affects one kidney only, and is more frequently met with after puberty.

Disseminated tuberculosis.—In this form minute miliary nodules are scattered through the kidney as a part of a general constitutional malady. These begin around the terminal branches of the arterioles that lie between the pyramids of Ferrein.

Tuberculous pyelitis and pyelo-nephritis.—In tuberculous pyelitis the disease commences with the formation of grey granulations in the pelvis and calyces, which, after amalgamating, form cheesy nodules, or result in pulpy ulceration. Pyelo-nephritis often commences in the substance of the renal papillæ and extends deeply into the kidney, as well as downwards to the submucous tissue of the renal pelvis. The body of the organ is enlarged and lobulated, while its pelvis and ureter are contracted by the thickening of their mucous and submucous membranes. In some cases the tuberculous material is deposited primarily and exclusively in the cortical part of the kidney, and in these cases can occasionally be entirely and successfully removed by excising a portion of the renal substance.

Symptoms.—*Disseminated tuberculosis* produces no characteristic symptoms referable to the kidney.

In the early stages *tuberculous pyelitis* does not give rise to marked constitutional symptoms, and local symptoms are absent. As the disease advances there is pain in the loin, with tenderness on pressure. Hæmaturia is sometimes a symptom. The urine, when it contains albumen, is always thick; not clear, or containing renal casts, as in Bright's disease. Occasionally there is suppuration or fatal uræmia. If the disease is on the left side the spleen may be so pushed forwards as to give the impression that that organ is enlarged. Vesical irritation is sometimes a very distressing symptom. In the advanced stages there are marked rigors and exhausting sweats, or hectic.

Diagnosis.—In the early condition it is almost impossible to diagnose tuberculous kidney from renal calculus. The chief reliance must be placed on the well-known constitutional signs of tuberculosis. The **prognosis** is most unfavourable, but the duration of the disease is very variable. In some persons it goes on for years.

Treatment.—The treatment suitable for tuberculous disease in other organs is here indicated. If the kidney has been converted into an abscess cavity of large size, or if suppuration has been set up in the perinephric cellular tissue, nephrotomy should be performed, and the cavity well irrigated and drained.

Operative treatment is useless in the miliary form of tuberculosis, as it is always secondary to general tuberculosis. Moreover, it is not generally diagnosed during life. In the caseous form, limited to one kidney, and in tuberculous pyonephrosis of one kidney, nephrectomy has been a fairly successful means of prolonging life.

It must be borne in mind that both kidneys are affected in rather more than fifty per cent. of all cases, and the working capacity of the other kidney must be therefore most carefully inquired into before performing nephrectomy. The difficulty in obtaining this necessary information is often very considerable, and the state of affairs can only be cleared up, in many cases, by direct examination with the hand through an incision in the linea semilunaris. In some cases I have treated tuberculous deposits by free erosion and the application of iodoform emulsion. In others I have

excised two, three, and more wedges of the renal tissue and sutured the cut surface, with very excellent results.

Tumours of the kidney.—Renal tumours are among the most difficult of abdominal enlargements to diagnose correctly.

The chief **distinctive points** about them are as follow :

1. The large intestine is in front of the tumour. The right kidney, unless enlarged, lies a little way from the lateral wall of the abdomen, behind and to the inner side of the ascending colon. When enlarged, the ascending colon is usually placed in front of, and towards the inner side of, the tumour. On the left side the descending colon is in front, and inclines towards its outer side below. Bowel is never placed in front of a splenic tumour.

2. There is no line of resonance between the kidney dulness and the vertebral spines : and no space between the kidney and the spinal groove, into which the fingers can be slipped with but little resistance, as there is between the spleen and the spine.

3. Renal tumours do not always project backwards to any marked extent. They may cause a little fulness ; but, as a rule, they only efface the natural hollow of the loin. Tumours due to disease of the kidney enlarge in front.

4. The kidney is rounded in every part of its surface and marginal contour, and a renal tumour, whether solid or cystic, partakes of this distinctive feature.

5. Renal tumours are often influenced to only a comparatively slight extent by the respiratory movements.

6. When the pelvis of the kidney is dilated the resulting tumour may press upon the liver, so as to be indistinguishable from it : it may, and often does, reach down into the iliac fossa, and occasionally extends beyond the linea alba. As a rule, however, renal tumours never invade the pelvis, and they are frequently separated from the hepatic dulness by a resonant area.

7. When the tumour is large enough to reach the front wall of the abdomen, the point at which it comes in contact with it is commonly about the level of the umbilicus, or a little higher ; the lateral wall between the costal margin and crest of the ilium is then also bulged outwards.

8. Varicocele, which would not be likely to occur in a case of splenic or hepatic enlargement, has been met with by the author in several cases of tumour of the kidney.

Diagnosis of renal tumours.—1. *Hepatic tumours* pass downwards from beneath the ribs, and so rarely have any intestine in front of them that the presence of bowel in front of a tumour may be regarded as *almost* a sure sign that the tumour has not its origin in the liver. The sharp edge of a tumour of the right side, accompanied by symptoms of jaundice, exclude the probability of its renal nature. An enlarged gall bladder, however, has in some cases bowel in front of it, and there fixed by adhesions.

2. *Enlargements of the spleen.*—Splenic tumours are movable : renal tumours are not usually so. The enlarged spleen has no

bowel in front of it, and generally presents a sharp or well-defined edge, sometimes notched, beneath which the fingers can be passed. The tumour is traceable upwards beneath the ribs.

3. *Tumours of the suprarenal capsule* often encroach on and in great part destroy the kidney. Many cases of so-called sarcoma of the kidney are no doubt tumours primarily of the supra-renal capsule.

4. *Ovarian tumours*.—The bowel lies behind an ovarian tumour; both loins are resonant; the tumour grows from below, is generally more central, and either drags up the uterus or can be felt as a swelling in the pelvis on vaginal or rectal examination.

5. *Enlargement of the lymphatic glands*.—The diagnosis from renal tumour may sometimes be made by the independent enlargement of one or more of the lumbar glands not forming part of the tumour; by the abruptness of the outline; and perhaps a protrusion of the growth along the spermatic cord into the scrotum.

6. *Flatulent or fecal accumulations* in the cæcum and colon give rise to intestinal trouble, abdominal pain and colic, which, as a rule, render their diagnosis from tumours of the kidney easy. Cancer of the cæcum or colon has frequently been mistaken for a renal tumour.

7. *Fæcal abscess, perityphlitis, or inflammation around the sigmoid flexure*, will be distinguished by febrile disturbance, tenderness over the front of the affected part, and intestinal symptoms.

Solid tumours of the kidney.—*Carcinoma* occasionally occurs as a primary new growth in the kidney; but much more frequently is secondary to malignant disease elsewhere. Injury and the irritation of a calculus have, in several recorded cases, been the cause of primary carcinoma.

Sarcoma occurs of the round- or spindle-celled variety in adults after 30; or within the first few months of life; or as congenital renal sarcoma.

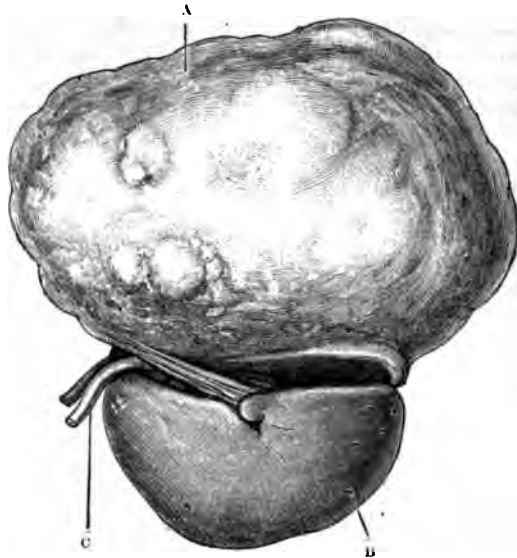


Fig. 876.—Renal Tumour originating in an Accessory Adrenal.
A, Tumour; B, kidney; C, ureter.

INJURIES AND DISEASES OF THE KIDNEY.

Renal sarcoma of the adult rarely affects both kidneys. Congenital renal sarcoma as often as not affects both kidneys.

The tumours grow rapidly, painlessly, and to a great size, and generally cause death by pressure effects; and are composed of structure similar to the zona fasciculata of the suprarenal capsule (fig. 876).

Many so-called tumours of the kidney arise in connection with the suprarenal bodies and not the kidney proper.

Rhabdo-myoma or myo-sarcoma.—Cases of renal tumour, probably of congenital origin and composed of striped muscle and sarcomatous tissue, occasionally occur. In some of the recorded cases the kidney structure has been invaded and destroyed, whilst in others the tumour has lain beneath the renal capsule upon the surface of the kidney.

Lymphadenoma occasionally invades the kidney.

Besides tumours of the kidney itself, the tissues surrounding the kidney are not infrequently the seat of new growths, especially lipomata and sarcomata.

Symptoms of renal tumours.—The presence of a tumour in the loin is an almost constant symptom. The tumour, though sometimes tender, is usually painless, until by increasing growth it exercises pressure upon surrounding structures. Carcinoma of the kidney causes frequent micturition and hæmaturia, and in some cases the irritability of the bladder is a very marked feature. The hæmaturia is sometimes slight, sometimes severe. It is in some cases the first symptom noticed before a tumour in the loin is detected.

Renal tumours may reach an enormous size. Eight or nine pounds is no uncommon weight, and sometimes they weigh as much as thirty or forty pounds.

Treatment.—This can only be palliative in the middle and later forms of the disease. In the very early stage nephrectomy offers the only chance of prolonging life. In children, tumours of the kidney, as elsewhere, run an extremely rapid and malignant course, and tend to recur very soon after removal. In adults nephrectomy, when performed for sarcoma in good time, has in several cases much prolonged life, as well as given immense temporary comfort. The disease, as a rule, however, recurs sooner or later.

Cysts of the kidney.—1. The numerous small cysts of granular kidneys never give rise to tumours, and are not amenable to surgical treatment.

2. **Conglomerate cysts**, or cystic metamorphosis of the kidney, is sometimes congenital, sometimes found in adults. The kidneys thus affected are occasionally of great size, and present themselves as abdominal swellings. These cysts are the result of a degenerative process. The whole kidney is converted into a vast number of conglomerate cysts of varying size, which leave unchanged scarcely any of the glandular structure. The kidney may weigh as much as five or six pounds, or even more. The contents of the cysts vary. The fluid may be clear, or straw-coloured,

or deeply blood-stained, and in consistence may be serous, limpid and transparent, or viscid. Sometimes the contents are purulent. The cysts do not communicate with the renal pelvis or with each other (Fig. 877). There are many theories as to their origin. When occurring at birth, or in early life, they are due to degeneration of embryonal tissues, and in these cases both kidneys are commonly

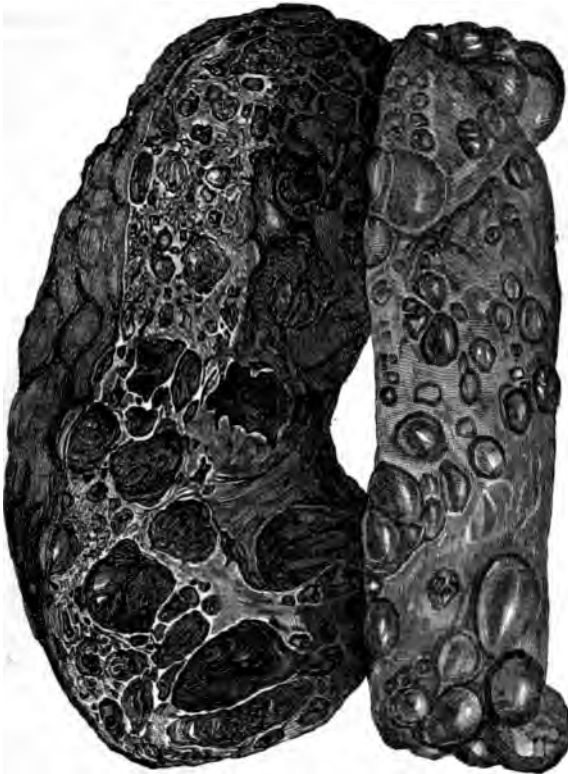


Fig. 877.—Cystic Degeneration of the Kidney. (Middlesex Hospital Museum.)

affected. In adult life, the majority of cases occur in persons of middle age or older, and are then not infrequently unilateral and of epithelial origin like adenomata. Pain in the loins and hæmaturia are frequent and pronounced symptoms.

Prognosis.—The progress of the disease is not usually rapid, but if bilateral is invariably fatal in its result. The course of the disease usually extends over two to five years. If the patient is not carried off by some intercurrent affection, vomiting, convulsions and coma, indicating uræmic poisoning, supervene, and then follows death.

Treatment.—The surgeon's aid is not often called for, owing to

the frequency with which both kidneys are affected. When the disease is unilateral, the elimination of urine is carried on sufficiently well by one kidney, and no treatment is requisite unless the size is very inconvenient. The author has in three instances removed polycystic kidneys on account of the distress they have caused, and the results have favoured their unilateral character.

3. **Dermoid cysts.**—These only occur in animals.

4. **Simple serous cysts.**—These, which are frequently seen in the kidneys of old people, may attain such a size as to constitute a disease of great importance. They cause no symptoms except



Fig. 878.—Section of Kidney with large simple Cyst, communicating with a Calyx. Renal pelvis dilated. (Middlesex Hospital Museum.)

those due to their size; probably not one-fourth of them reach a size large enough to attract attention; and not one-third could be detected if carefully sought for by palpation. These cysts arise in the cortex of the organ, and project in relief from its surface, the rest of the kidney being functionally active and healthy unless it be granular, or atrophied from the pressure of the cyst itself. The contents of these cysts are fluid, containing a small quantity of albumen and a little saline matter (Figs. 878, 879). They commence insidiously and grow slowly, gradually monopolising, as they increase, the greater part of the abdominal cavity. Hæmorrhage may take place into them, and cancer has been developed in their parietes. Some of them are probably due to obstruction.

Treatment.—As soon as they attain an inconvenient size they should be removed or incised and drained, but without interfering

further with the kidney than is actually requisite. Nephrectomy will rarely be justifiable.

5. Hydatids of the kidney.—These are comparatively rare.

The left kidney is nearly twice as frequently affected as the right. The cyst may be subcapsular, or lodged deeply in the substance of the organ. It forms an elastic, rounded, and sometimes fluctuating tumour, projecting from the surface of the kidney. The whole kidney may be ultimately destroyed by the cyst; in other cases the tumour remains quite small. A renal hydatid may burst into the pelvis of the kidney or into the intestine or lung. It may inflame and suppurate.

Symptoms. — In many instances these are absent. In some cases there are no symptoms until the cyst bursts, when attacks of renal colic begin. Sometimes there is an abdominal tumour, with or without the symptoms excited by the escape of the contents of the cyst along the urinary passages. Fluctuation

is not always to be detected. The hydatids discharged *per urethram* are in various states, broken or entire. When the parent cyst has suppurated before bursting, pus is discharged as well as hydatids. Blood sometimes escapes. The escape of the vesicles may, or may not, excite nephritic colic. Should suppuration occur, then rigors, fever, and increased pain and tension about the tumour set in.

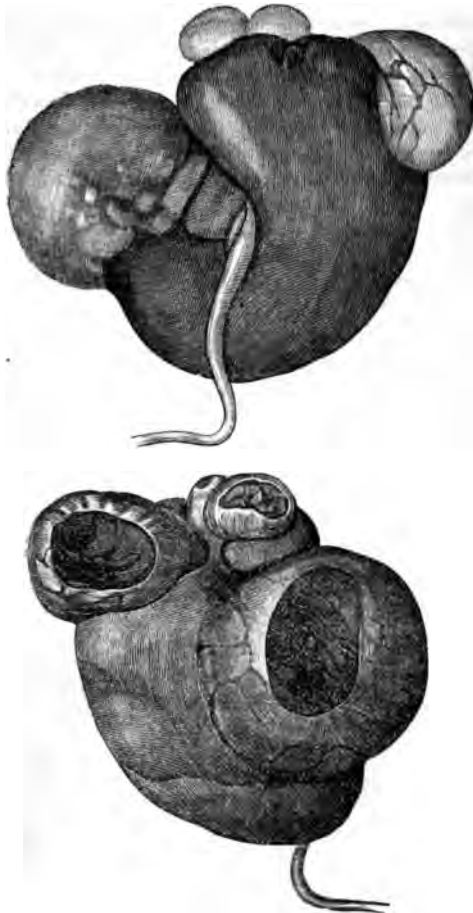


Fig. 879.—Two Views of a Kidney containing blind Serous Cysts. (Middlesex Hospital Museum.)

Prognosis.—This is not always unfavourable ; the duration of the disease is uncertain, but often very prolonged. There is no fatal case on record where the vesicles have escaped *per urethram* from a renal hydatid cyst which has *not* given rise to an abdominal tumour. When the cyst ruptures into the pleura or bronchi, the probability of recovery is not good ; but when into the stomach or bowels, the chances are more favourable.

Treatment.—When the tumour increases without discharging *per urethram*, the only proper plan is to treat it by incision and drainage, or, if requisite, by nephrectomy. It should be opened from the loin, if possible ; if not, then at its most prominent point.

INJURIES AND DISEASES OF THE URETHRA.

CONGENITAL MALFORMATIONS.

Hypospadias.—By hypospadias is understood an abnormal and congenital opening of the inferior wall of the urethra.

It is by no means a very rare malformation.

It is the result of an arrest of development in early foetal life. The urethra is developed in three portions : the prostatic and membranous urethra from the constricted tubular lower end of the

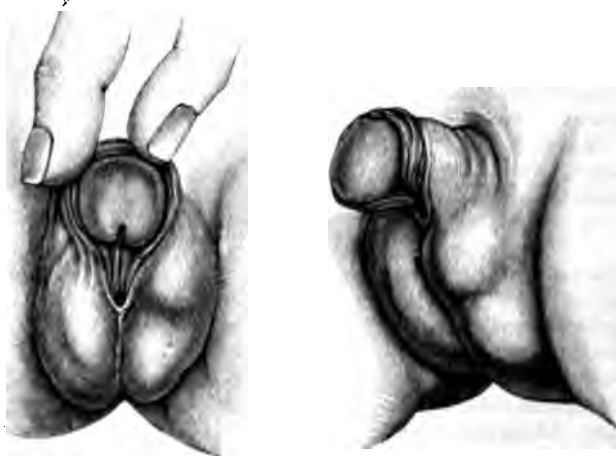


Fig. 880.—Peno-scrotal Hypospadias. (After Duplay and Reclus.)

urogenital sinus ; the spongy portion by the closing in below of the urogenital fissure posteriorly and of the groove beneath the genital tubercle anteriorly ; and the *balanic* urethra (i.e. the urethra of the glans penis), which is hollowed out in the epithelial ridge on the

inferior aspect of the glans, and subsequently joins the spongy portion of the urethra.

Any arrest in the evolution or union of these three component parts will result in one or other of the forms of hypospadias.

Varieties.—1. *Hypospadias of the glans penis* (balanic hypospadias) appears most frequently as a longitudinal groove open below and formed by the superior wall of the navicular fossa. The urethral mucous membrane is continuous with the adjacent integument, and is often valve-like, so as to mask the entrance to the spongy urethra. This orifice is frequently contracted so as scarcely to admit a pin. There is a corresponding gap in the under part of the prepuce.

2. *Penile and peno-scrotal hypospadias.*—The floor of the spongy part of the urethra between the bulb and the glans penis is wanting, and there is seen a moist vascular furrow, or more or less of a canal or a dense band of fibrous tissue, in place of the corpus spongiosum. With the latter condition, the penis is curved downwards and backwards on the scrotum (Fig. 880).

In the penile hypospadias the urethra may open at any point between the peno-scrotal junction and the base of the glans. In the peno-scrotal form the orifice of the urethra is immediately in front of the scrotum, but the scrotum is not bifid. There may be both the balanic and peno-scrotal forms of hypospadias present in the same subject.

The corpora cavernosa and glans penis are frequently well developed in this second form; but the prepuce, meatus, glans and penis may be malformed; and the nearer the urethra terminates to the scrotum the more likely are these malformations to be present.

3. *Scrotal and perineo-scrotal hypospadias.*—In this form the arrest of development occurs earlier than in the other two, and the result is a near approach to the normal female formation, and to the condition wrongly called hermaphroditism.

The penis is imperfectly developed and always curved downwards; the scrotum is cleft (Fig. 881); the urethra opens in the perinæum; and the testicles may be small, ill-formed, ectopic, or retained, but if properly descended each will occupy the separate scrotum of its own side.

Symptoms.—The nearer the aperture is to the scrotum the more inconvenient is micturition. Persons with scrotal and perineo-scrotal hypospadias must micturate in the squatting posture. An



Fig. 881.—Hypospadias with Cleft Scrotum. (After Orth.)

INJURIES AND DISEASES OF THE URETHRA

irritating erythema of the scrotum is caused by the frequent contact of urine in certain cases of the peno-scrotal group. If the urethral orifice be small or valve-like, symptoms like those of stricture may be produced, and in many cases there has been retention of urine. Incontinence of urine never occurs in hypospadias, because only the parts in front of the membranous urethra are involved. In scrotal and perineal hypospadias, and in all cases where the incurvation of the penis is extreme, the sexual functions are imperfect, if not impossible.

Diagnosis and prognosis.—As a rule there is no difficulty in the diagnosis. Should there be a fold or flap hiding the small aperture, it is only necessary to make the patient pass water to detect the abnormal opening. The history and general appearance will prevent a small hypospadias from being mistaken for a penile fistula. The sex of the subject in extreme cases of scrotal hypospadias will be settled by the detection of the testes in each lip of the vulviform slit, or in the inguinal canals; by the absence of a uterus interposed between a catheter in the bladder and the finger in the rectum; and by the absence of the catamenia, as well as by the outward appearance and voice.

Treatment.—Hypospadias of the glans penis rarely needs any treatment. Operative treatment is indicated in the penile and peno-scrotal varieties. This will take the form of a plastic operation, the steps of which consist in first making an external meatus at the glans; then in covering in the penile portion of the passage from the glans to the abnormal orifice; and thirdly, in freshening the ends of the old and new canal, and joining them together by horsehair sutures. The wetting of the flaps with urine and the thinness of the tissues from which they are fashioned militate strongly against success, and failure is frequent. It is better, therefore, to defer operative measures until puberty, when the sympathetic intelligence of the patient will prove of valuable aid to the surgeon. Exception to this rule must be made in those cases where micturition is seriously interfered with by the narrowness or valve-like formation of the urethral orifice. Such cases should be operated upon without delay. In the extreme forms of hypospadias with cleft scrotum, etc., operative treatment is of little value.

Epispadias.—In epispadias the urethra is exposed for more or less of its extent along the upper surface of the bladder. It may or may not be associated with extroversion of the bladder. Epispadias has been variously explained, but most of the theories are directly in conflict with embryological facts. It is not, properly speaking, a division or deficiency in the upper wall of the urethra, but in the floor of the urethra, which has been transposed to the dorsal aspect, owing to torsion, of the penis. It is thus, in fact, a hypospadias reversed—i.e. upside down (Fig. 88). Compared with hypospadias it is very rare. The proportion of the two sets of cases is 1 to 150.

Varieties.—There are three degrees of epispadias :—(1) The

confined to the glans ; (2) where besides the glans portion a part of the spongy urethra is also defective ; and (3) where the epispadias is complete and extends the whole length of the penis.

In the first two degrees the penis is short but large, and the corpora cavernosa are complete. In the third degree, which is by far the most frequent, the penis is short and stunted and curved upwards and backwards, torsion is more or less manifest, the glans penis is normal, the corpora cavernosa are often defective or absent, and the prepuce is abundant, but often reduced to half its circumference. It is in this third degree that the several complications occur, such as extroversions and hernia of the bladder, separation of the pubes, and various abnormalities of the testes.

Symptoms.—These depend upon the degree. When the whole length of the urethra is involved, incontinence of urine must necessarily be always present. In the lesser degrees this is not so ; but micturition is more or less interfered with, and, like hypospadias, epispadias suffer much from the wetting of the surrounding parts with urine whenever they micturate. Sexual functions are always difficult or impossible. The subject will be further considered under Ectopion Vesicæ (page 919).

Treatment.—Several plastic operations have been practised with some measure of success. As in hypospadias, they have for their object the formation of a canal for the urine in place of an open gutter. For the different methods employed and their various details, the student is referred to works on operative surgery.

Imperforate urethra.—The urethra may be either incompletely or completely imperforate. **Incomplete imperforations** are most frequently met with at the meatus, or a little way down the glans portion of the urethra, especially at the spot where this latter joins in the process of development with the spongy portion. The meatus may be simply very narrow, or it may be contracted by valves. A contracted meatus ought not to be ignored ; it causes in some cases cystitis, in others the symptoms of vesical calculus. It also tends to prolong urethritis and gleet, and thereby tends to induce stricture and dilatation of the ureters and kidneys. The only proper treatment is to divide the meatus with a blunt-pointed tenotome, and any sclerosed ring higher up the canal by the internal urethrotome.

c c 2



Fig. 882.—Epispadias. (After Ammon.)

Complete imperforations occur either with or without an abnormal exit for the urine. They consist either (1) of a diaphragm or (2) of a transformation of part of the urethra into a fibrous cord.

Any complete occlusion without an abnormal exit for the urine, if it persists through the latter half of fetal life, must result in dilatation of the bladder, ureters and kidneys.

If, on the other hand, there be an abnormal opening for the urine, these disastrous changes need not occur. Such abnormal openings may be situated on the under surface of the penis, or in the perinæum, or in the front wall of the rectum.

Treatment.—In complete simple occlusion the obstruction should be broken down either with a tenotome or a sound. Where the urethra is converted into a mere fibrous cord attempts, when possible, should be made to fashion a new urethra.

Other anomalies of the urethra.—In very rare cases the urethra may be absent altogether, or in cases of double penis there may be two urethræ; and lastly, flask-like dilatations of the urethral floor are sometimes seen in the neighbourhood of the glans penis; these dilatations, in a few cases, were capable of enormous distension, and, in one case, of holding all the urine discharged from the bladder.

INJURIES AND INFLAMMATION OF THE URETHRA.

Rupture of the urethra.—The urethra may be ruptured at any point from the prostatic portion to the meatus, but the most frequent seat of injury is the bulbous or membranous portion.

Causes.—Penile rupture of the urethra is rare, but it has been ruptured in the flaccid condition of the penis by a kick from a horse, and also in the erect condition of the penis by undue violence during coitus, or by forcible bending of the penis on its dorsum. By far the most frequent and most important forms of rupture of the urethra occur from violence to the perinæum, either by the individual falling astride of some resisting body, or from a kick or other blow inflicted upon the perinæum. It may also occur conjointly with fracture of the pelvis, either by the penetration of the urethra by a broken fragment of bone, or by its being violently dragged upon and torn by the deep triangular ligament which is displaced with the broken bone.

When the rupture is caused by falls astride, it is situated at the bulbous portion of the urethra. Contusions of the perinæum caused by blows from before backwards will likewise rupture the urethra at this point, whereas direct blows on the posterior part of the perinæum directed from behind damage the membranous portion of the urethra immediately behind the bulb. In every case it is the pubis which acts as the *point d'appui* for the rupture. In fracture of the pelvic bones it is the membranous urethra which is most commonly ruptured.

Symptoms.—In *penile rupture of the urethra* there will be

sudden pain at the moment, a few drops of blood from the meatus, and a little ring-like thickening at the seat of injury, and that may be all at the time, but, later, a hard and intractable stricture follows. In other cases the symptoms are much more severe, the hæmorrhage is very free and recurring, there is complete retention of urine from blood-clot, and the pain at the moment of rupture may have been intense.

The symptoms of *perineal rupture of the urethra* present the greatest variety in their degree of severity. In some few cases the pain is slight and soon passes off; there is but little difficulty or pain in micturition; there is slight ecchymosis of the penis and perineum, but only slight, if any, swelling along the course of the urethra; the bleeding from the urethra is so slight as perhaps to have escaped the notice or the memory of the patient, and a catheter can be passed at once and with ease. But the subsequent effects may be most serious owing to infiltration of urine, inflammation and septicæmia, hence the necessity of carefully watching such cases for many days. In a far greater number of ruptures hæmorrhage from the urethra is free, continuous, or recurring; micturition is very difficult and painful, or there is partial or complete retention of urine; there is a swelling in the perineum with ecchymosis extending more or less over the scrotum to the penis and thighs, and after a variable time the surrounding tissues are blown out with urine extravasated through the rupture. The extravasation of urine is generally limited by the attachments of Colles's fascia, which will prevent urine leaking into the thighs or ischio-rectal fossa.

The urine will first distend the perineum beneath Colles's fascia, and on further extravasation it will distend the scrotum and penis, and finally find its way beneath the fascia of the abdominal walls in front of the planes of abdominal muscles. In these situations it may form large fluctuating swellings that ultimately break down and suppurate if left to themselves. The amount and extent of the infiltration will depend upon the length of time that has elapsed between the accident and the time that the patient is seen, the size of the rupture, and the freedom with which urine is able to pass into the tissues. It must be remembered that the injury itself, or the pressure of urine, or both, may do away with ordinary anatomical barriers, and that therefore urinary extravasation may occur in almost any direction. If extravasation is free, the discomfort experienced from retention of urine will at first be small, as the bladder for a time can relieve itself by emptying its contents into the surrounding tissues.

If the rupture is incomplete, it may be possible to pass a catheter if its beak follows the roof of the urethra, which is the last part of the urethra to be torn; but if the rupture is complete, the introduction of a catheter is impossible, and attempts to introduce it can do nothing but harm. If the case is left to itself, suppuration, sloughing, and gangrene will speedily appear in every part where urine has extravasated, a general septicæmic infection will take

place, and death will probably occur in a few days. Even if the patient survives these processes, he will be left with several troublesome urinary fistulæ and a traumatic stricture of the most fibrous and inelastic kind.

Diagnosis.—In rupture of the penile urethra, whether the patient is suffering from chordee or not, there is pain at the moment, followed by a few drops of blood from the urethra at least sufficient to stain the linen. The slight annular swelling around the urethra, and subsequently the development of a stricture, likewise point to the nature of the accident which has happened.

After a fall or a blow on the perinæum, the discharge of blood by the urethra is sufficient to show what has happened, even without any of the other symptoms of rupture.

In the more severe cases of rupture of the bulb or membranous urethra, the symptoms are too marked to allow room for doubt.

The diagnosis as to the precise *situation* of the rupture will be made by careful inquiry as to the mechanism of the injury. As to the *degree* of injury, one is generally justified in concluding, where the symptoms are slight, that a part of the circumference of the tube is torn, and that, the inferior part or floor. Where the symptoms are very severe and well marked, we may fairly assume that the tube is torn across.

The doubtful cases are those in which there is no urethral hæmorrhage and where the patient can, at first, pass urine and there is no extravasation of urine. But in a day or two, or perhaps within a few hours, the diagnosis can be made from symptoms which become well developed.

Treatment.—In slight cases where there is no retention catheterism is needless, and may be dangerous, since it may excite bleeding which did not previously exist, and will tend to retard the healing of the wound.

In all cases, however, a close watch should be kept for infiltration of urine or inflammation of the injured parts.

In all cases in which partial or complete retention, urethral hæmorrhage, slight or much, and a swelling in the urethra, small or great, are present, external urethrotomy or perinæal section should be done, whether a catheter can be passed or not. There should be no temporising with a catheter retained in the bladder, hoping that hæmorrhage will be thus controlled and extravasation of urine and septic infection of the parts will be avoided.

An early perinæal section provides for the evacuation of blood and blood-clots from the wounded tissues; it enables the surgeon to control hæmorrhage completely and also thoroughly to disinfect the wound. It enables a catheter to be introduced and retained, without inflicting unseen damage upon the lacerated parts, and it is the best means of preventing or minimising the subsequent stricture.

In all cases the torn edges of the urethra should be approximated, and as far as possible accurately adjusted by sutures of cat-gut or fine silk. If, however, a considerable time has elapsed since

the accident, and the tissues are much inflamed or gangrene threatens, sutures will be useless. If the torn ends are much bruised or lacerated, it will be advisable to cut a portion of them away before applying the sutures.

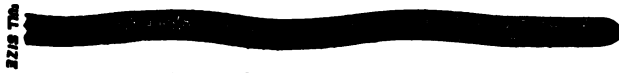


Fig. 883.—Jacques Catheter. (Weiss.)

The catheter around which the urethra has been sutured should be retained from five to eight days, and afterwards a Jacques (Fig. 883) or gum-elastic catheter (Fig. 884) should be passed daily; or if the patient can pass the catheter easily upon himself, it would be well for him to use it for a week or two each time he wishes to micturate.

If extravasation of urine has already taken place when the patient is first seen, free incisions must be promptly made in all the



Fig. 884.—Gum Elastic Catheter. (Weiss.)

invaded areas, and the parts well irrigated and drained. If the infiltration of urine has been extensive, and has existed for any considerable length of time, the patient will need stimulants and careful constitutional treatment to tide him successfully over the dangers incurred therefrom.

False passages and how to avoid them.—Another class of wounds of the urethra are those caused by the ignorant, or careless, or too forcible use of catheters and sounds.



Fig. 885.—Olive-headed Catheter. (Weiss.)

They are of the nature of contused and lacerated wounds.

In a normal urethra false passages ought never to be made. Strictures of the urethra, enlargements of the prostate, abnormally large lacunæ of Morgagni, the dilated orifices of mucous glands, and lacunar recesses in the prostatic urethra in which the point of an instrument can catch, are the conditions under which false passages are likely to be made. Another predisposing cause is the flaccidity of the perineum of old men, and the readiness with which the bulbous part of the urethra, owing to its feeble support in these subjects, becomes depressed by the point of an instrument carelessly or roughly handled.

Symptoms.—As there is much less resistance to an instrument in passing it along the natural channel than in piercing the mucous

membrane, the hand that makes the false passage probably realises at the moment an extra resistance, which it overcomes by the use of some amount of force. It should never be forgotten that *no force whatever* ought to be used in passing an instrument into the bladder. A sound or a lithotrite if properly handled will go along the urethra and enter the bladder by its own weight, and if a check occurs in its transit just as the handle of the instrument is about to be depressed between the thighs of the patient lying on his back, this will easily be overcome by raising the handle and withdrawing it a little, and then pressing with a slight downward drag over the hypogastrium with the other hand, just as the handle of the instrument is again lowered.

The lighter and gentler the manipulation of the instrument, the easier will it pass into the bladder; and if an obstruction is felt, the catheter should be "coaxed," but not forced past it.

If the instrument is pushed out of the canal and to one side, it will no longer keep in a line with the *linea alba*, but the handle will be deflected to the side opposite to that on which the point has penetrated the urethra wall. This deflection need not occur, however, if the urethral floor and not the lateral wall is penetrated. So that the inexperienced surgeon must not be confident he is in the urethra merely because the handle of his instrument is in the median line.

The other symptoms are hæmorrhage, pain, abnormal resistance to the onward progress of the instrument, and the detection, by the index finger in the rectum, of the misplacement of the end of the instrument below or behind the prostate, and too near the bowel.

Rigors, fever, extravasation of urine, perineal inflammation, and urinary abscess are the general and local complications that may arise. As a rule, in men in fair health, no inconvenience is felt by the patient beyond slight hæmorrhage and the pain caused by the catheter, if he is kept in bed and no further instrumentation allowed till the wound is healed.

Treatment.—To avoid making a false passage, the best course is to be very gentle and light of touch, and to keep the point of the instrument towards the roof of the urethra. The advantage of hypogastric pressure has been alluded to above; its *modus operandi* consists, I believe, in diminishing the curve of the urethra and in putting it more upon the stretch—i.e. in making it "taut."

The object of catheters, *coudée* or bent up at the extremity, and of instruments with a strong curve, is to avoid the various irregularities, and especially those of the prostate, that occur along the floor of the urethra. They are particularly of use in enlargement of the prostate.

Another precaution is to keep the penis well drawn up over the instrument, especially whilst passing it through the membranous portion, and just before depressing its handle between the patient's thighs. In a case of false passage associated with stricture, in which a catheter is needed, the soft olive-headed instruments (Fig. 885) should be used

or a fine soft bougie should be passed, and then screwed to the end of a Holt's or Perrève dilator, and after the stricture has by this means been dilated, the urethra should be left uninterfered with by further instrumentation until the false passage has quite healed. If the patient can empty his bladder, no instrument whatever should be passed until after the false passage has healed. Where there is retention, and catheterism is difficult or impossible, suprapubic aspiration should be performed, and repeated, if required, for three, four, or more days; by this means the urethra is placed at rest, the false passage is allowed to heal, congestion of the bladder and urethra cease, and in seventy-two hours, more or less, an instrument can probably be introduced without difficulty.

As a rule, there is no need of hæmostatics; but if hæmorrhage is severe, ice to the perinæum, the avoidance of instruments, the use of which will certainly cause fresh bleeding, and the internal administration of ergot or witch hazel will suffice.

If pain and inflammation are present, warm fomentations should be applied to the perinæum, consisting of lead and carbolic, or lead and opium lotion.

Foreign bodies in the urethra.—Very many and various are the foreign bodies that have been introduced into the urethra by insane and hysterical patients. Hairpins, slate pencil, sticks, seeds, feathers, pins, and needles are amongst the number. Besides these, surgical instruments, such as catheters, have been broken in the urethra, either during operations, or when tied in, or in being passed; and small renal calculi have become impacted at the neck of the bladder or in the deep urethra.

Foreign bodies may either remain in the urethra, or be driven out by the rush of urine in micturition, or travel into the bladder. It is probably very rare for them to be expelled through the meatus. A smooth round body like a pea is the most likely to find its exit in this way.

When retained in the urethra they may find a resting-place either in the penile or deep portions of the canal, becoming fixed either by partially piercing the urethra wall, or by catching in the orifice of a lacuna or gland duct.

In a considerable number of cases the foreign body reaches the bladder, and there becomes coated with phosphates and forms the nucleus of a calculus.

Symptoms.—Foreign bodies impacted in the urethra, as a rule, cause such serious inconvenience and trouble that surgical aid is soon obtained. When retained for weeks, months, or, as in some rare cases, for several years, they become encrusted with the salts of the urine, and cause dilatation of the urethra behind. That their residence for any length of time should be possible, urine must be able to escape by them. It is in the deep perinæal part of the urethra chiefly, in the prostatic occasionally, in the penile portion rarely, if ever, that the foreign bodies are thus lodged for a long time.

The first symptom excited after the introduction is a sharp pain

in the urethra, radiating to the thighs, perinæum, and abdomen: this is much more severe as long as the body is in the penile portion than when it reaches the perinæum, where the sensation is more that of a weight.

Micturition is always more or less, and may be completely, obstructed. If, however, the body be such as a hairpin or a piece of tobacco-pipe, or catheter with its long axis in the axis of the urethra, the bladder can be readily emptied; even then micturition

becomes more frequent, owing to reflex irritation at the neck of the bladder. Inflammation is soon set up in the urethral mucous membrane with discharge from the meatus, and this may extend to the scrotum, perinæum, or bladder, or along the vasa deferentia to the testicles. If the case is neglected, these conditions may become chronic. Abscesses form outside the urethra, followed by urinary fistulæ, and suppurative pyelo-nephritis may slowly destroy the kidneys.

Treatment.—If the body be smooth and rounded or oblong, it may be expelled by gripping the end of the penis during micturition and then letting go, so that the rush of the urine shall carry the foreign body with it. If retained within the penile urethra, the attempt at extraction through the meatus with urethra forceps (Figs. 886, 887), or a fine, blunt-ended probe

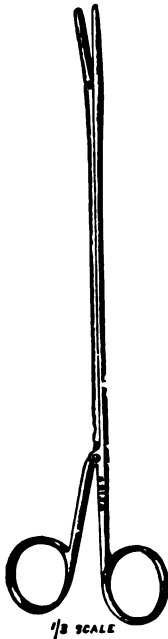


Fig. 886. — Mathieu's Urethra Forceps. (Weiss.)



Fig. 887. — Sir H. Thompson's Urethra Forceps. (Weiss.)

sharply curved back near its end, may succeed. If not, rather than continuing to make fruitless efforts at extraction, or running the risk of lacerating the urethra by forcing the body back into the bladder, or subjecting the patient to needless anxiety or danger by delay, the foreign body should be deliberately cut down upon and removed *in situ*, through a longitudinal incision, and the urethra should then be immediately and accurately sutured by buried catgut or fine silk sutures, as described in the treatment of ruptured urethra (page 870). A catheter should be retained for a few days.

Calculi in the urethra.—These are of two kinds: (1) those which are formed on the spot; and (2) those which are conveyed

into the urethra by the urine stream, and are retained there for a longer or shorter time.

1. Those which are formed in, or in one of the recesses of, the urethra are composed of phosphate of lime. They are found occasionally in the recess on the floor of the urethra left after the healing of a perinæal section, or external urethrotomy; or in an urethral fistula, or an enlarged or dilated lacuna or pouch.

2. Calculi which have passed into the urethra from the kidney or bladder, and have been retained there for a time, differ from those formed entirely in the urethra by having a nucleus and stratified layers. The renal calculi are generally small, round, flattened, or elongated and smooth, composed of uric acid, and of a grey or greyish-red or buff colour, but may be rough and uneven.

The bulbo-membranous portion of the urethra, and the canal just behind the meatus, are the common seats of, and infancy is the commonest age for, impaction. Impaction may, however, occur at any age.

Penile calculi have, in several instances, ulcerated through the urethral wall, and then, either in the scrotum or within the prepuce, have gone on increasing to a great size. In other cases the calculus, having ulcerated through the urethra, comes to occupy a recess which subsequently may communicate with the urethra only by means of a very narrow orifice, so that little or no evidence of its presence can be detected by a sound in the urethra. In other cases, again, the calculus, after impaction in the membranous urethra, has gone on growing, and has extended backwards into the bladder, and there increased in mushroom fashion. Urethral calculi are usually single, but several small calculi or two or more calculi of much larger size may be contained within an enlarged prostatic urethra. If a calculus has ulcerated through the urethral wall, urinary infiltration of the surrounding tissues and abscess are apt to follow and complicate the case.

Symptoms.—An impacted urethral calculus causes sudden stoppage in micturition. The patient, during the act of passing water, feels something enter and travel along the urethra till the stream stops, or nearly stops. In children this is generally the first symptom; in adults there have, as a rule, been previous renal and general symptoms suggestive of renal or vesical calculus, lithiasis, or lithæmia. Besides retention, or sudden stopping of the stream, there may be no other symptom. Pressure along the course of the urethra will reveal the presence of a hard body; the introduction of a bougie, catheter, or sound will detect it. Palpation per rectum will assist in deciding whether the calculus is in the bladder or in the prostatic or the membranous urethra.

Treatment should be the same as for foreign bodies in the urethra (page 873). A smooth-surfaced stone in the deep urethra should, if possible, be pushed back into the bladder, and there crushed and removed by litholapaxy. But urethrotomy, followed by urethrorrhaphy, is so safe and successful that it is to be preferred

to any forcible efforts to return the stone (especially one with a rough surface) to the bladder for the purpose of lithotripsy.

When a calculus is impacted behind a stricture, external urethrotomy is indicated as the means of removing the calculus and dividing the stricture at the same time.

By urethrotomy and the use of immediate sutures, impacted calculi may be removed from the penile as well as from the perineal urethra, with confidence that, with well-applied buried sutures and due observance of aseptic precautions, the results will be perfectly satisfactory.

Non-specific urethritis.—Urethritis is an inflammation of the mucous membrane of the urethra, and may be either of a specific or non-specific nature. The specific variety is known as gonorrhœa, and is elsewhere treated of (p. 433, Vol. I.). Non-specific urethritis may arise from many causes. Excessive sexual indulgence, leucorrhœal or menstrual discharges, exposure to cold, the over-use of certain aromatic drugs, such as turpentine, balsams, and iodide of potassium, may one and all excite an urethritis. It may also be produced by an excess of lithic acid or oxalate of lime in the urine. Foreign bodies impacted in the urethra or the presence of a retained catheter may cause urethritis from direct irritation, and, more rarely, the disease is set up by reflex irritation excited by hæmorrhoids, fissures, or vesical calculus.

Symptoms and diagnosis.—The symptoms are somewhat the same as those of gonorrhœa, but much less intense. A sense of heat, of fulness and tenderness along the urethra, with a cutting or scalding sensation during micturition and a muco-purulent discharge, sufficiently characterises the disease.

It is of importance to bear in mind that one who leads the purest of lives may be the subject of an acute urethritis, and that, for the peace of mind of others as well as of the patient himself, the surgeon should be able to diagnose the non-specific from the specific form.

In simple urethritis all the symptoms are much less acute than in gonorrhœa. There are never the itching, pain, and gaping of the external meatus, in the beginning; nor the chordee during the course of the attack, as in gonorrhœa. Simple urethritis usually ceases spontaneously in a few days after the removal of its cause, and never leaves behind a persistent gleet as gonorrhœa so frequently does.

Treatment.—This resolves itself into ascertaining the cause and removing it by appropriate means.

When the inflammation arises from digestive disturbances and an over-acid state of the urine, a carefully regulated diet, avoiding fats, sugar, and alcohol, and the administration of alterative and tonic medicines such as soda and gentian, or the mineral acids and preparations of iron, are required.

Cowperitis and Pericowperitis.—This is an inflammation of Cowper's glands and the surrounding cellular tissue. The inflammation may be acute, and is then most commonly seen occurring in the

third or fourth week of gonorrhœa as a tumour the size of a haricot bean in the vicinity of the urethral bulb. The tumour soon loses any definition of outline, owing to the involvement of the neighbouring tissues, and the condition is then easily confounded with an urinary abscess, especially as in some cases delay in opening a Cowperian abscess gives time for perforation of the urethra. Other causes of acute inflammation are traumatism, applied to the urethral mucous membrane by catheter, or sound, or contusions from without. Chronic inflammation may result from the acute form or be due to the invasion of the gland by tubercle.

Diagnosis.—It is most likely to be confounded with a periurethritis. Pericowperitis most commonly occurs in the third or fourth week of gonorrhœa, when periurethritis is of rare occurrence. If only one gland is involved, the swelling will be confined to one side of the middle line, and not, as in periurethritis, be found occupying the middle line or extending equally across both sides of the middle line. Practically, the differential diagnosis between the two affections is not important, as similar treatment should be employed in either case.

Treatment.—Early incision if suppuration has set in. In the early stages of inflammation the ordinary remedies of acute inflammation, such as ice or fomentations, etc., should be employed.

STRICTURES OF THE URETHRA.

By stricture of the urethra is understood a persisting diminution of its calibre by sclerosis, or by a cicatrix in its walls.

Varieties.—The so-called "inflammatory" and "spasmodic" strictures of older writers are falsely called "strictures." Inflammation and spasm are, indeed, causes of temporary obstruction and retention—in the one case owing to the congestive tumefaction of the mucous membrane; in the other, owing to spasm of the muscular parietes of the canal, or of the muscles surrounding the canal—but these conditions are not "strictures."

Ætiology.—The two common causes are inflammation and injury. Thus we have "simple organic strictures," due to sclerosis following inflammation; and "cicatricial strictures," following rupture or injury. The frequency of the former is to the latter as fourteen or fifteen to one.

Cicatricial or traumatic strictures.—A stricture may follow any form of injury to the urethra. The bulbous and membranous parts of the urethra are the commonest situations of cicatricial strictures. Their extent depends upon the extent of the injury that causes them. They are nearly always single, generally crescentic, and occupy the floor and sides of the urethra; occasionally they are completely annular. They are frequently irregular or tortuous, generally very hard and cartilaginous, offer great resistance to instruments, and rapidly contract after dilatation. In some very severe cases the urethra is completely obliterated immediately in

front of the rupture. They are often complicated with abscess, with obstinate fistulæ, and secondary changes in the kidney, ureters, and bladder, resulting in what are called "surgical kidneys." They are developed with great rapidity.

Simple organic (or inflammatory) strictures.—These are by far the commonest, and form what some authors speak of as the "simple organic strictures." They are not to be confounded with the cases of retention of urine due to a swollen or œdematous condition of the mucous membrane during the height of an acute urethritis or gonorrhœa, which cases the old writers used to describe as inflammatory strictures. These simple "organic" (inflammatory) strictures are the result of a repetition of attacks of inflammation, gonorrhœal or otherwise, and they occur at a considerable time after the attacks have subsided. Whilst traumatic strictures follow quickly their cause, the inflammatory are tardily produced and often delayed for years.

The conditions favourable to the production of these simple organic (inflammatory) strictures are profuse or prolonged suppurations, vascular changes favourable to arterio-capillary sclerosis, and any irritation within the canal. Astringent injections have been indiscriminately blamed. Whilst there was probably much truth in the accusations brought against the former use of solid caustics, there is little, if any, in those made against the mild astringent solutions which it is now the custom to use. Anything that tends to prolong an urethral inflammation predisposes to stricture.

Pathological anatomy.—**Traumatic strictures** consist of typical fibrous tissue, the thickness, form, extent, and degree of irregularity of which depend on the nature and extent of the original injury.

The (inflammatory) "simple organic" strictures are frequently multiple. They are met with commonly in the fossa navicularis, in the anterior third of the urethra, in the subpubic portion, and in the scrotal and bulbous portions of the urethra. The bulbous is the most common seat. On laying open the urethra in the usual manner in the cadaver, the slender fibrous submucous ring which alone constitutes some strictures actually disappears. In some extreme cases the greater part of the urethra is prettily uniformly indurated.

The length of the stricture varies much, and the stricture tissue does not end abruptly but gradually, so that it is not always possible to distinguish a line of limit between the healthy and abnormal tissues. The degree of stricture varies extremely. It is, however, quite exceptional for the urethra to become completely occluded. There is always a passage through these strictures, though it may be tortuous and of capillary fineness.

When annular, the anterior orifice of the stricture may be in the axis of the urethra, or to one side of it. If not annular, the stricture may involve any side of the tube, but is most frequently on the floor. It may present a smooth and gradual eminence to the bougie, or be obtuse and ledge-like.

The urethra is, in old-standing cases, dilated behind the stricture, and may be enlarged into a pouch, the walls of which become trabecular from enlargement of the lacunæ of the mucous membrane. The changes in the tissues which constitute simple (inflammatory) organic stricture start from the mucous membrane and invade in turn every structure forming the urethral walls. So that in the beginning, and in slight cases, only the mucous membrane, or the mucous membrane and the submucous tissue, are involved, whereas in very advanced and long-standing strictures the corpus spongiosum throughout, including its fibrous sheath and the tissues of the perinæum outside the sheath, are sclerosed.

Symptoms.—A stricture, in the first place, causes symptoms that have reference to the stream of urine and the manner of micturition; it is thus an urethral affection. The stream is altered in form, in its manner of leaving and in the distance to which it can be projected from the meatus; and if the obstruction is sufficient, it will be entirely arrested. In order to overcome the obstruction, the bladder has to make compensatory efforts, and may be worn out by over-exertion or prove too feeble to respond; it is also exposed to the risks of inoculation either by extension of urethritis or through catheterism. Vesical symptoms then appear, and are superadded to the urethral. Finally, the ureters and kidneys, exposed to the effects of the urethral obstruction, namely, to the forcible and frequent vesical contractions, and to the decomposition of urine, are dilated and suppurate, and add to the gravity of the condition and unfavourably determine the prognosis.

Symptoms referable to the urethra.—Too much attention has been given in the descriptions of the symptoms of stricture to the “forked,” “twisted,” “corkscrew-like,” and other variations in the form of the stream of urine; but these changes are generally due to a narrow meatus, or to the agglutination by mucus, or muco-pus, of the lips of the meatus, and not to the stricture. A narrow stricture may be present without any such change in the stream; or the changes in the form of the stream may occur independently of stricture. A stricture quite near the meatus might have the same effect as a narrow meatus, but not so a stricture at the bulb with the anterior part of the canal and the meatus of normal size. With regard to the power of projecting the stream, it must be borne in mind that the bladder is more concerned than the stricture.

If the bladder is feeble the stream will not be projected far, whether there be a slight stricture or no stricture at all. On the other hand, if the muscular tissue of the bladder is good, and has become hypertrophied owing to the obstruction, the projection of the stream will be powerful, though the lumen of the stricture may be small.

Undoubtedly, in neglected stricture there comes a time when the bladder gets the worst of the competition; it can make no further efforts to compensate for the obstruction; or it no longer has the contractile power of earlier years. If the patient is feeble

to start with, from age or disease, then we may expect loss of power in the bladder in quite the early stage of stricture; otherwise not.

Symptoms referable to the bladder.—Frequent and painful micturition are the first symptoms complained of in some cases. They are of vesical origin and due to congestion or inflammation about the neck of the bladder, and are delayed for a longer or a shorter time according as the bladder has or has not time and power to become accustomed to and to overcome the obstruction of the stricture. If not, the stagnation and the decomposition of the urine in the bladder will very soon set up cystitis and its attendant symptoms.

At variable periods men with stricture are apt to get attacks of *acute retention*. A sudden chill, sexual indulgence or excess, indiscretions in eating and drinking, or going an undue length of time without passing water, may be the cause of this.

Acute retention occurs most frequently in cases of long-standing stricture and may last for twenty-four hours or more. It is due to spasm or congestive tumefaction of the urethra and when it has passed off the patient makes water as before its onset. Another common cause of retention is the impaction of a plug of stringy muco-pus in the lumen of the stricture.

Incontinence is a symptom of stricture and may occur in three different conditions of stricture. Firstly, it may occur as a little dribbling of urine for some time after micturition. This is due to the retention of a little urine in a dilated urethral pouch behind a stricture and this urine is forced out through the stricture drop by drop by the contraction of the urethra.

Secondly, this dilatation of the urethra behind a stricture may go on extending until the neck of the bladder is involved and no longer serves as a sphincter. The urine then involuntarily escapes, especially in the standing or sitting position. If, in addition, the urine becomes ammoniacal, the bladder gets so irritated that expulsive efforts become more and more frequent and violent and a condition of continual dribbling of offensive urine is set up. At this state of affairs the patient's life is one of constant suffering and, from constant straining to micturate, secondary complications are apt to occur, especially prolapsus ani and hernia, and even cerebral hæmorrhage.

Thirdly, incontinence may occur as a symptom of retention, either during an acute attack from leaking of the overcharged bladder, or from the same cause in the more chronic condition of an old and neglected stricture.

The first effect of stricture on the bladder walls is a slowly increasing hypertrophy of its muscular coats, which diminishes its capacity. When inflammation sets in, the nutrition of the muscular wall is impaired and the bladder, gradually weakening, becomes unable to cope with the resistance offered by the stricture. Retention of urine then makes its appearance and slowly increases, *pori*

passu, with the weakening of the muscular coats. The bladder becomes less and less equal to its duties and slowly dilates, until its original capacity is far exceeded and its muscular coats are thinned and stretched. This condition may increase until the bladder walls become completely atonic or incapable of any expulsive effort.

Symptoms referable to the kidney.—From the time the bladder ceases to perform its functions naturally, the kidneys are threatened in a double manner: (1) by mechanical distension; (2) by ascending inflammation and suppuration. At this stage the general system rapidly suffers. What has been called “the urinary cachexia” sets in. The digestive organs are disturbed, the mouth gets dry and furred, the tongue is reddened at its tip and edges, and its dorsum is dry and coated; thirst is great, the appetite is lost, vomiting and diarrhœa occur; there are attacks of feverishness alternating with periods when the temperature goes below normal in the morning and is little above normal at night; the face becomes sallow, pains in the loins are troublesome, the urine becomes purulent, and the patient dies of urinary poisoning.

Diagnosis.—There is the clinical history to guide—either of traumatism or frequent gonorrhœa, or of a long-standing gleet. The question of a contracted or swollen meatus or a tight prepuce should be cleared up at once. The first symptoms of stricture, in many cases, are undue frequency of micturition, with or without some pain during the act, or an attack of acute retention. It is well to remember that the patient with stricture strains through the whole act of micturition; the man with enlarged prostate at the beginning; whilst one with vesical calculus does so at the end. The exploration of the urethra with an olive-headed bougie will remove any doubt. In passing the instrument, begin with a full size and gradually work down to the size which passes easily through the obstruction, so as in this way to avoid the error of overlooking a stricture of “large calibre.”

To distinguish between stricture and spasmodic contraction, use a metal instrument instead of a flexible one. This instrument will be obstructed at the membranous part of the urethra by spasm, and a slight gentle pressure will often cause it to pass on through the spasmodically contracted part of the canal. On withdrawing the instrument there will be no gripping of it as there is when a stricture is present.

Prognosis.—This chiefly depends upon the promptitude with which proper treatment is commenced and the regularity with which it is continued. If the stricture is dilated early, and the proper patency of the urethra subsequently maintained by the occasional introduction of a bougie, all will continue well. If, on the other hand, the stricture is left to take its own course untreated, sooner or later vesical and renal complications will arise.

A traumatic (cicatricial) stricture is more severe and rapid in its effect than a simple organic (non-traumatic) one. All the conse-

quences of stricture are, as a matter of course, more rapidly progressive in old men with arterial sclerosis, or enlarged prostate, or chronic renal disease, than in young men with healthy organs.

Treatment.—This is (a) mechanical, and consists in dilatation, divulsion, electrolysis, internal or external urethrotomy, or perineal section; and (b) constitutional, consisting in an unirritating diet, good hygienic conditions, and aseptic precautions.

Dilatation.—All agree that for a large number of cases dilatation is sufficient, and that when it is so, no other operation should be substituted for it; moreover, it is nearly always requisite, as a complementary measure in maintaining subsequently the good effect of the other modes of treatment.

The most favourable conditions for dilatation are single recent inflammatory strictures in young men. The most unfavourable are traumatic strictures, especially when complicated with perineal fistulæ, and strictures with a long and tortuous lumen. Other conditions which militate against success by dilatation are: an extremely irritable mucous membrane that bleeds readily; neurotic and highly sensitive subjects who cannot endure or have not the courage to submit to instrumentation; and men who are subject to attacks of urinary fever after every introduction of a catheter.

There are two ways of employing dilatation not always suitable for the same case: (1) dilatation without detention; and (2) dilatation with detention. It may be here premised that in all cases of stricture, if there is a narrow meatus it ought at once to be enlarged.

1. *Dilatation without detention* (or interrupted dilatation as it is sometimes called) does not confine the patient to bed, because a catheter is not retained in the bladder. It is suitable for men who cannot or will not give up their time wholly to their treatment, who are not restricted to a limited time within which to be treated, and upon whom, even though the stricture may be very narrow at the commencement of treatment, there is no uncertainty or difficulty in introducing instruments.

To carry out this treatment, the patient first passes water to clear the urethra of any muco-purulent discharge. The glans and meatus are carefully cleansed, and the meatus enlarged if contracted. The urethra is then distended with a drachm or two of simple olive oil or weakly carbolic oil; and whilst still distended an olive-headed bougie is passed, of such a size as is found by trial to pass readily through the stricture. This is to be left in for a few minutes and then to be withdrawn, and the next in size larger passed immediately, and after another few minutes' detention the next larger still, until two or three have been passed. After one or two days' rest the same process is repeated, always commencing by passing the one or two largest instruments passed at the previous sitting. In this way the urethra may be fully dilated in from ten days to three weeks.

(2) *Dilatation with detention* (or continuous dilatation, as it is

sometimes called). By this plan the patient is confined to bed, or, at any rate, to his room and his couch. A catheter is passed, with the precautions just given, and is tied in the bladder, and allowed to remain twenty-four or forty-eight hours, when it is removed and another catheter, one or two or more sizes larger, is tied in. The rule should be that the catheter to be detained should glide easily within the strictured area. A catheter that nearly or quite fills the lumen irritates the diseased part, and, if there is any breach of surface, tends to increase the risks of absorption or extravasation of urine; whereas a catheter that passes loosely through does neither; but in a rapid manner, which is often surprising, promotes the absorption and relaxation of the stricture tissue. A week or less is very often quite sufficient for full dilatation. During the retention of a catheter the front part of the urethra should be frequently syringed out with Condyl's fluid, or a weak solution of boric acid.

This mode of treatment is suitable for the same class of stricture as "dilatation without detention," when the patient can give up the time for it, or when it is not requisite his treatment should be compressed within a few days. It is the best, therefore, for the in-patients of a hospital.

Acute retention.—It must be remembered that it is frequently a sudden attack of retention of urine that first brings the patient with stricture under the care of the surgeon; and, moreover, that attacks of retention are apt to complicate the treatment by interrupted dilatation. The treatment of acute retention may be therefore well considered at this point. When first seen during the attack an attempt should be made to pass a soft olive-headed catheter. If this fails, a silver instrument should next be tried and may often succeed where the soft catheter has failed. Should the surgeon fail to pass any instrument, as may especially happen if the case has not had any recent treatment for the stricture, a full dose of opium and a warm bath, and an attempt at catheterisation in the hot bath may be tried, provided that the patient is in fairly good health and strength. But if the patient is old and feeble, the hot bath must be applied with caution, if at all, as serious syncope has been induced by it. If it does not succeed, or cannot be tried, and in any case if the retention is extreme, the bladder should be punctured above the pubis with the aspirator syringe, or trochar and cannula.

The effect of thus emptying the bladder is to relieve the congestion of the mucous membrane, and the spasms, and the patient may be able to pass water, or the surgeon to introduce a catheter within a few hours afterwards.

Medicinal aid in treatment.—In another class of cases the stricture may be so long and narrow, or there may be so much spasm or congestion of the mucous membrane, that the surgeon is at the first unable to introduce any instrument, although retention of urine does not occur. In such cases the patient should be kept in bed on a light farinaceous diet, with a moderate amount of barley-water to drink; and, if the urine

is acid, a mixture should be taken of bicarbonate of potash (grs. x) and tincture of hyoscyamus (℥ xxx) three times a day. The patient after a few days of this *régime* often experiences an improvement in passing urine, and by the end of a week or ten days the

surgeon may slip in easily a No. 2, 3, or 4, though before the treatment commenced the stricture may not have admitted a filiform bougie. This point gained, dilatation with detention—*i.e.* the continuous dilatation treatment—should be employed.

If this expectant treatment should not succeed, anaesthesia should be induced and catheterisation. If this succeeds, a catheter may be tied in and the patient afterwards treated by the continuous dilatation method, or the stricture may be there and then dealt with either by the internal urethrotome or by rapid stretching of the stricture with Holt's or Perrève's dilator.

Should the surgeon fail under anaesthesia to pass even a filiform bougie, by which to guide the internal urethrotome or dilator into the bladder, recourse should be had

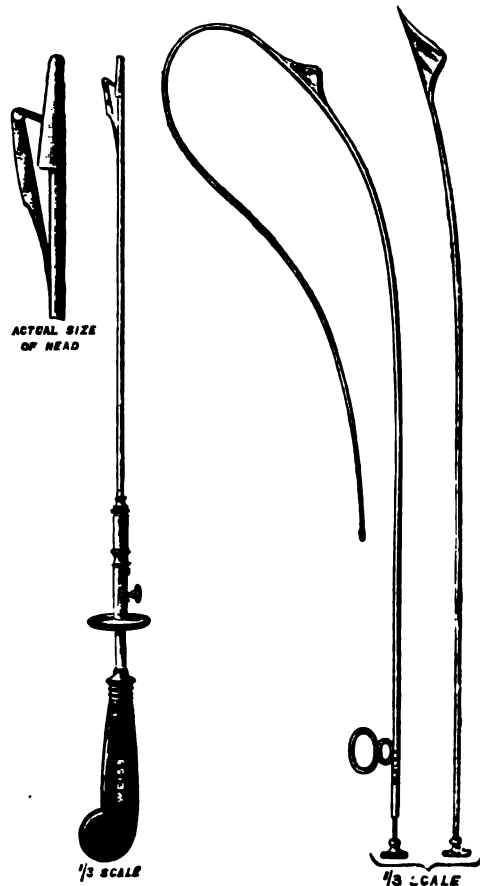


Fig. 688.—Sir H. Thompson's Urethrotome. (Weiss.)

Fig. 689.—Maisonneuve's Urethrotome. (Weiss.)

to perineal section and the stricture divided after Cock's, Wheelhouse's, or Sedillot's methods, and a full-sized catheter subsequently tied into the urethra.

Divulsion.—This is effected by Holt's or Perrève's dilator, and consists in the rapid dilatation of a stricture by means of passing a series of tubes, gradually increasing in size, along a sheathing tube with split sides, wedge fashion. For strictures in the bulbo-

membranous urethra that do not require external urethrotomy or perineal section, it is an excellent form of treatment if properly used. The tubes should be passed steadily without any jerking, and each tube should be allowed to rest quietly for several seconds before being withdrawn.

Electrolysis.—This method does not seem to offer any advantages over antiseptic internal urethrotomy, either in regard to its simplicity, safety, or the greater stability of its results.

Internal urethrotomy.—By this method the stricture is divided through its lumen by a sheathed knife passed down the urethra. Many different varieties of instruments have been devised (Figs. 888, 889), in some of which the knife, sheathed, is passed through the stricture, and then, unsheathed, is withdrawn, cutting its way out through the stricture. To use such an instrument, the stricture must be capable of holding a No. 5 or 6 catheter. In other forms of instruments the knife, sheathed, is passed down to the stricture and then protruded, and is pushed slowly through it. Any instrument that necessarily cuts the roof of the urethra should be avoided.

Internal urethrotomy is the operation *par excellence* for penile strictures. It is also to be recommended for strictures in which dilatation of any form is insufficient or harmful, such as (a) cartilaginous stricture, (b) resilient strictures, (c) irritable strictures which bleed, or become readily inflamed, (d) which are frequently complicated by retention, cystitis, or orchitis, (e) when incontinence shows that there is considerable retro-strictural dilatation, (f) when instrumentation causes urethral fever, and when the kidneys are threatened.

A disposition to urethral fever, and the presence of vesical and renal complications, are not reasons against, but in favour of, the operation; because fever may be prevented or checked, a free passage provided, and the kidneys and bladder relieved from overdistension by the operation.

External urethrotomy.—This consists in cutting through the stricture upon a staff passed into the bladder. It is the operation for choice (a) in traumatic strictures, (b) in strictures complicated by extravasation of urine, (c) in cases where there are perineal fistulæ, especially when the fistulæ are old, hardened, and tuberculated, (d) in strictures that have returned after internal urethrotomy has been performed, and (e) in cases in which the patients, being careless, intemperate, or poor, will not or cannot attend to the regular periodic introduction of an instrument, requisite after dilatation or internal urethrotomy.

Perineal section consists in opening the urethra behind the stricture without a staff to cut upon, or Cock's operation. This, or Sedillot's or Wheelhouse's operation, is indicated (a) for strictures which are practically impassable—i.e. when no instrument can be passed of any kind after careful, prolonged, and repeated trials, aided by rest and dietetic treatment, and by anæsthesia; (b) in cases

of retention where no instrument can be introduced under *anæsthesia*, and where the urine is known to be thick and purulent, and the

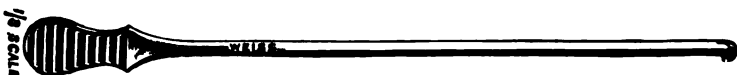


Fig. 890.—Wheelhouse's Staff. (Weiss.)

bladder inflamed; (c) and also where no instrument can be passed. in cases of extravasation of urine, or urinary abscess due to perforation of the urethra behind the stricture. In Wheelhouse's operation (Figs. 890, 891, 892) the urethra is opened in front of the stricture; a director is passed through the narrow orifice of the stricture, and the latter divided from before backwards. My own method is to pass, where possible, a filiform bougie into the bladder and screw this into a straight grooved staff (Fig. 893), which is made to follow the bougie as far as it can into the stricture. The staff is then cut down upon, and little by little, as the stricture is divided, the staff is pushed farther on until at length the whole stricture is divided.

For the various details of these operations the student is referred to works on operative surgery. There is no operation for stricture that can compare with external urethrotomy, and perineal section with division of the stricture from behind forwards, for the excellence and permanence of the relief afforded.

In all cases of stricture, whatever be the method employed for its cure, there is a certain tendency to relapse. This tendency is very much more marked in some strictures, and after certain forms of treatment, than in others; but, in any case, the patient should either learn to pass a catheter for himself and do so from time to time, or he should apply to the surgeon to do so for him, and thus the return of stricture can be avoided. The frequency with which an instrument should be passed will depend on the merits of each case, and must rest with the surgeon to decide according to the tendency of the stricture to reapse. Excision of the stricture and suturing of the divided ends has been done with success.



FULL SIZE

Fig. 891.—Wheelhouse's Grooved Probe. (Weiss.)

EXTRAVASATION AND RETENTION OF URINE.

Urinary abscess and extravasation of urine.

—When a breach is made in the wall of the urethra, either by injury or disease, and is unaccompanied

by a free external opening, urine escapes into the adjacent cellular tissue, and the result is either an abscess or extravasation.

If the urine issues slowly and in small quantity, and becomes circumscribed by inflammatory exudation, an abscess forms.

If the urine escapes suddenly or rapidly and in large quantity, it spreads far and wide in the tissues, unchecked by a barrier of inflammatory origin, and "extravasation of urine," properly so called, is produced.

Traumatic causes.—Extravasation may be caused by any of the kinds of wounds of the urethra

described in previous sections. If the penile portion is ruptured during erection or coitus, or if the bulb is torn by a blow or fall on the perinæum, the urine will infiltrate the anterior and superficial part of the perinæum, and may spread thence to the scrotum, penis, and front wall of the abdomen.

If the membranous or prostatic portion is ruptured, the urine will es-

cape between or behind the triangular ligaments, and, spreading thence to the anus and ischio-rectal fossæ, may ascend a long way upwards into the pelvis. Thus it may infiltrate between the pubo-vesical ligaments into the pre-vesical space, and in severe and neglected cases may mount as high as the iliac fossæ, or even spread in the retro-peritoneal cellular tissue along the front of the vertebral column. It may also break through the anterior layer of the triangular ligament and become diffused throughout the superficial part of the space.

The natural anatomical frontiers of the two perinæal spaces may be broken through, either at first by injury, as in fracture of the pelvis, or subsequently by suppuration, and in either way the extravasation may become general.

Pathological causes.—The pathological ruptures occur spontaneously and, as a rule, in the following manner:—The

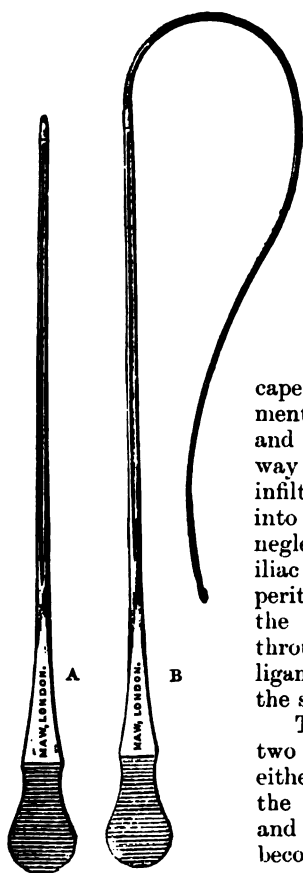


Fig. 893.—A, Morris's Tapering Staff; B, with Filiform Guide-bougie attached. (Maw.)

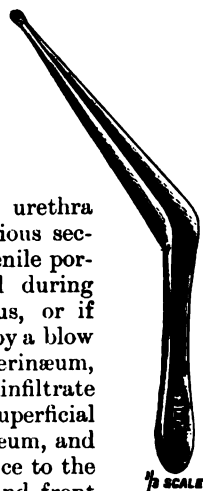


Fig. 892.—
Wheel-
house's
Gorget.
(Weiss.)

urethra behind a stricture, or other persistent cause of obstruction, is dilated, and the little urine constantly lodged here causes a degree of chronic inflammation, or even ulceration, with thinning of its walls. This effected, it only needs an attack of complete retention, or of increased difficulty in micturition, to be superadded to that which persistently exists, for the wall of the canal to give way under the more frequent and forcible muscular efforts of the bladder to expel its contents. Sometimes the rent in the urethral wall is large and the urine escapes rapidly, and then extravasation ensues; in other cases the breach is small and

even minute, and the urine escapes *guttatim*, or nearly so, and then an abscess is the consequence.



Fig. 894.—Abscesses resulting from Stricture. One abscess is in the prostate, the other behind the bladder. Both abscesses communicate with the bladder cavity. A bristle marks the urethra. (Middlesex Hospital Museum.)

Urinary abscess.—If the patient be in bad health, or the subject of secondary kidney disease, if there is a frequent leakage of urine, or if the urine is not aseptic, suppuration will occur early, and an acute or subacute abscess will be formed. If none of these conditions is present, there may remain for a long time a quiescent, small, hard, fixed lump outside the canal giving rise to no symptoms and showing no signs of suppuration until a slight injury, or some irritation about the urethra, starts a suppurative process, and an abscess is formed that runs a similar course to the preceding.

The *acute and subacute abscesses* are nearly always situated

in the perinæum immediately beneath the urethra, but as they increase they approach both the scrotum and anus. They cause at first a small swelling, oblong or round in shape, hard to the touch, painless, and covered by healthy skin. In a few days they increase markedly and become painful, micturition is smarting or burning, the whole perinæum is tender, rigors occur, and the general symptoms indicative of local inflammation and suppuration are excited. At this stage the abscess (1) may burst into the urethra, when thick yellow pus is discharged with the urine, or drains away at the meatus independently of passing water, or can be squeezed along the passage; (2) or it may point towards the surface, and break, leaving a urinary fistula; or (3) without breaking through the skin, the abscess may burst into the bladder, or into the surrounding tissues, when wide spread extravasation may follow (Fig. 894).

The *more chronic variety* is not so common. When once supuration has been set up, the pus may follow any of the courses just mentioned as occurring in the acute variety.

Diagnosis.—This will, in most cases, be made without difficulty by attending to the clinical history and symptoms.

Treatment.—Although the urethra is not always clearly connected with the abscess, and urine does not invariably flow out through the incision when the abscess is opened, the urethra is, nevertheless, invariably involved by the abscess, and urine will, in almost every instance, trickle through in a day or two, if not at the time of opening the abscess. It is right, therefore, before making even a superficial incision into one of these abscesses, to inform the patient of its connection with the canal, and of the possibility of an urinary fistula following; otherwise the surgeon may be blamed for want of skill in treating the case.

To prevent the abscess from bursting into the urethra, or from leaving a tortuous fistula, or from causing urinary extravasation, it ought always to be opened in good time.

Softening and fluctuation are not to be waited for, nor should the swelling be allowed time to enlarge either towards the anus or scrotum. It is best to cure the stricture at the same time that the abscess is opened by cutting through the inflamed walls on to a small staff, and, whilst opening the abscess, to divide the stricture in front of it. Other strictures, if existing, should be dealt with at the same time, either by the internal urethrotome or by rapid dilatation.

In every case the contents of the abscess should be well cleared out, the abscess wall scraped and well rubbed with iodoform.

If the abscess has burrowed, as it very likely will have done, in a forward direction above the scrotum and towards the roof of the urethra, or laterally by the side of one of the cavernous bodies, the sinus should be cleared out in the same way as the abscess, and, if necessary, a counter opening should be made in the integuments and a drainage-tube introduced.

No catheter should be left in the urethra, but as soon as healing begins the urethra should be kept dilated by passing every few days a full-sized instrument.

Extravasation of urine.—Extravasation of urine differs essentially from urinary abscess, although it occurs from the same pathological and mechanical causes. The tissues are infiltrated with urine so suddenly and in such large quantity that they have no time to become inflamed, and thus, by throwing out a barrier, to prevent further infiltration. The consequences are dependent upon the quantity, and the degree of septicity, of the urine extravasated. It is true that pure, healthy urine can be poured out into a large vascular cavity without doing harm, until by its stagnation, decomposition, and widespread absorption under pressure, inflammation, supuration, gangrene, or septic absorption occurs.

Symptoms.—When extravasation occurs in front of the triangular

ligament, as it most frequently does, the perinæum in its anterior half becomes tense and swollen. The deep layer of the superficial fascia, attached as it is behind to the base of the triangular ligament and along the sides to the ischio-pubic rami, directs the urine forwards into the scrotum, penis, and front abdominal wall. All of these parts may become much enlarged by œdema if the extravasation is great enough. If the rupture is behind the triangular ligament, the urine passes backwards and upwards into the pelvis in the manner previously described.

In traumatic cases the extravasation does not always occur immediately or rapidly. In these cases, too, the urine is often healthy and unirritating, so that it is slow to cause inflammation or fever—in fact, it does not do so until it has undergone secondary changes, and therefore some days may elapse without serious local or general symptoms, if a catheter has been retained in the bladder. Again, the urethra behind the rupture may retract, or be closed by the compressor urethræ, or be blocked by blood-clot, and, further, the shock of the accident checks the secretion of urine; so that in this way again the local symptoms may be postponed for many hours.

When the urethra gives way behind a stricture, it is generally during an effort of the patient to pass water whilst his bladder is pretty well distended. Perhaps he is unable to start the stream, or has the pain of retention, when suddenly he feels a sense of great relief in his bladder without voiding any urine through his meatus. The bladder has partly emptied its contents into the tissues of the perinæum. But, in little or no time, in less than an hour perhaps, there are external evidences in the perinæum and scrotum of what has happened. Sooner or later—sooner if the urine is septic or a large quantity of it is poured out at once—the perinæum suddenly becomes tumid and tender, then red and painful, and here and there showing bullæ or spots of gangrene; fever progresses and rigors occur, and septic intoxication, or septicæmia, may follow very rapidly if operative treatment be postponed.

Diagnosis.—There will rarely be any difficulty. The history and course of the case ought to exclude diffuse suppurative cellulitis or erysipelas. If the extravasation is entirely limited to the deeper parts, diagnosis is more difficult; but here again the clinical history will be of much value.

Prognosis.—In most cases of simple extravasation, when treated in good time, the patients are at once relieved of fever, rigors, and pain by the incisions, and in three or four days are rapidly convalescing. Feeble, intemperate, unhealthy people, and those whose higher urinary organs are disorganised, run great risks, and recovery with them is much slower. Extensive sloughing will be followed generally in fairly healthy persons by rapid granulation and cicatrisation, and though both testes may have been bared of their integuments, they will soon become covered in again by newly-formed tissue.

Treatment.—This consists in making immediate, multiple, and

free incisions into the perinæum, scrotum, penis, abdominal walls, ischio-rectal fossæ, or wheresoever the urine has penetrated, so as to provide exits for it, and to prevent fresh infiltration. Never wait for fluctuation. In the perinæum the incisions should be made in a longitudinal direction, and on each side of the middle line; in the scrotum and prepuce transversely, obliquely, or longitudinally.

As the floor of the urethra near the rent, in cases of pathological origin, is commonly in an ulcerated or sloughy state, it is proper to perform, at the same time that the incisions are made, external urethrotomy, and thereby to divide the stricture as well as the damaged urethra. This should be done also for the purpose of giving a direct exit to the urine from the bladder, and thus preventing further infiltration of the tissues.

In cases of extravasation from injury, the rent in the urethra should, if the case be seen early, be closed by fine catgut or silk sutures. This treatment will, however, be useless in cases where several hours have elapsed after injury, and the tissues are inflamed or gangrenous (page 870).

In the septicæmic and gangrenous cases with a tendency to coma, and a temperature descending below normal, only a fatal ending can be looked for. Neither free incisions, nor quinine, nor large quantities of stimulants and nourishment, are likely to prevent it.

Retention of urine.—By retention of urine is meant the total inability to micturate voluntarily, and the term must be distinguished from “retained urine,” which is applied to a certain quantity of urine that is left in the bladder after the completion of the act of micturition. Retained or “residual” urine occurs in cases of enlarged prostate, tumours of the bladder, etc., where obstruction at the vesical orifice prevents the bladder from completely expelling its contents.

Ætiology.—The various causes of retention of urine may be classified under two main headings: (1) obstructive causes; (2) non-obstructive causes.

1. *Obstructive causes.*—(a) Obstructions of a congenital nature; under this heading come cases of imperforate or contracted meatus, imperforate prepuce, torsion of the penis, and congenital phimosis.

(b) Impaction of a calculus or foreign body in the urethra.

(c) Stricture and the chronic enlarged prostate of advanced life.

(d) Abscess of the prostate or penis, perineal abscess, and abscess in the neighbourhood of the rectum.

(e) Congestion and spasm of the urethra, occurring with or without organic stricture and during the course of a gonorrhœa, urethritis, or gleet. This is the commonest cause of retention of urine in men, and it is usually induced by venereal or alcoholic excess, or by the passage of an instrument such as a catheter or sound down the urethra.

(f) Tumours of the bladder, penis, and prostate.

(g) Pressure on the neck of the bladder from without by tumours of the pelvis or by a retroflexed gravid uterus.

2. *Non-obstructive causes*.—These are due to some abnormal condition of the nervous mechanism of micturition.

(a) Hysterical retention of urine. This occurs much more frequently in women than in men.

(b) Injury to the spinal cord, as in certain cases of fracture and concussion of the vertebral column.

(c) Diseases of the spinal cord, such as locomotor ataxy.

(d) Reflex paralysis of the detrusor muscle, or excessive reflex contraction of the sphincter muscle of the bladder, induced by surgical operations, especially by those in the neighbourhood of the rectum. The reflex centres for the bladder are situated in the segments of the spinal cord corresponding to the 2nd, 3rd, 4th, and 5th sacral nerves; the reflex motor centre of the sphincter is a trifle higher than that for the detrusor vesicæ, they are quite distinct from and antagonistic to one another. Paralysis of the centre of the sphincter leads to incontinence, paralysis of the centre of the detrusor to retention, of urine. The continued action of the centre of the sphincter also causes retention.

(e) Certain drugs, such as belladonna.

(f) Retention of urine sometimes accompanies profound shock. It is also occasionally a complication of peritonitis, the continued fevers, and may occur in the late stages of wasting diseases.

Symptoms.—These vary considerably in acuteness, depending upon the cause of the retention, the length of time it has existed, and the condition of the urinary organs prior to the attack.

In cases where the urinary organs are healthy, except perhaps for a slight stricture or a gonorrhœa or gleet (and these form the large majority of all cases), the symptoms are acute in their onset, and rapidly increase in severity if relief is not obtained. They consist in a total inability to pass water; and this inability is accompanied by a constant and urgent desire to micturate, which rapidly increases to pain and agony. Accompanying this are severe attacks of tenesmus, during which prolapse of the bowel or a hernia may occur. There is tenderness over the lower part of the abdomen in the region of the distended bladder. The latter may, in thin subjects, be seen as an indefinite oval tumour in the mid-line of the abdomen, and sometimes extending as high or higher than the umbilicus. Percussion shows dulness over this area and sometimes, by careful palpation, fluctuation may be made out. If the bladder be very much distended, there is often present the incontinence of retention—that is to say, urine leaks out of the urethral meatus drop by drop as the overflow of an over-brimming bladder. Such leakage can afford no relief to the symptoms, as the distension of the bladder remains unrelieved.

When the urinary organs are not healthy, as in subjects of long-standing or narrow organic stricture, or senile hypertrophy of the prostate, the onset of symptoms is often much less acute. In these

cases the bladder is frequently much increased in size, and is habituated to a chronic state of partial distension owing to the incomplete expulsion of its contents at micturition. This distension of the bladder continues to increase, until at length a condition of complete distension and atony of the bladder is arrived at, and voluntary micturition is abolished, the only passage of urine being effected by constant dribbling from the overflowing bladder. This state of affairs is only reached gradually, and may be present for some considerable time without exciting any acute symptoms. In other cases the complete retention is actually brought about by some slight congestion at the neck of the bladder, set up by exposure to cold or wet, or the passage of a catheter, or by alcoholic excess.

Results of retention.—In acute cases of retention, complete relief of symptoms will follow the emptying of the distended bladder; but if such treatment is not speedily adopted, the backward pressure on the ureters and kidneys will lead to a total arrest of their powers of secretion, and the patient will begin to suffer from the effects of anuria and consequent uræmic poisoning. The pulse will become small and rapid, low muttering delirium will set in, and, if still unrelieved, convulsions, coma, and death will speedily follow. In the second class of cases, where the retention comes on gradually, the prognosis is more grave, for in all probability the kidneys will have for some considerable time suffered from the constant effects of a partially distended bladder, and will be either hydronephrotic or in a state of pyelo-nephritis. Relief of the retention will not cure these permanently damaged organs; and the effects of a complete retention may so interfere with their already diminished vitality as to render them incapable of performing their functions, and bring about a fatal issue to the case, even after relief has been afforded.

Treatment.—The relief of the distended bladder by the withdrawal of the urine should be effected without delay. The means adopted will vary with the cause of the retention. If this is due to imperforate or contracted prepuce, the prepuce must be slit up. If a calculus or foreign body be impacted in the urethra it must be removed, excised, or crushed, according to the rules laid down in the treatment of these affections. (See pages 874, 875.) When retention is due to other causes than these, relief must first be sought by means of the catheter.

Catheterisation.—In cases of stricture, urethral spasm, obstruction by tumours and abscesses, and affections of the spinal cord, a soft catheter, preferably a Jacques or an olive-headed instrument, should be selected for the first trial. A soft instrument should be chosen because it excites less spasm, causes less discomfort, is less likely to produce hæmorrhage in a congested urethra, and if the practitioner is inexperienced in catheterisation, is less likely to do harm to the urethral walls. A catheter of medium size (No. 7 or No. 8, English series) should be selected; for if the retention is simply due to urethral congestion and inflammation, a medium-sized instrument will more readily overcome the spasm than a smaller one, while, on

the other hand, if an organic stricture be present, a fairly large instrument will most readily inform the surgeon as to the size and nature of the obstruction. A small catheter is apt to hitch and catch in the folds of the urethra, and so to convey an entirely false notion as to the capacity of the stricture. In all cases the utmost gentleness must be practised.

Should a medium-sized instrument fail to pass, trial must be made of successively smaller instruments. If all soft instruments, after a fair trial, fail, then an attempt should be made to pass a silver catheter. If a catheter is successfully passed, but much difficulty is experienced in introducing it, it should, when possible, be tied into the urethra for some hours.

In cases of retention due to prostatic hypertrophy, a soft coude catheter will be often found to pass when attempts with an olive-headed or gum-elastic catheter fail. A catheter of the ordinary length may also fail to reach the bladder owing to the increased length of the urethra. In such a case use must be made of special prostatic catheters (Fig. 899), which are longer and have a larger curve than other instruments. As in stricture, a fairly large instrument should be first tried, and will very often succeed. Silver instruments should be given a trial if soft catheters fail. If the patient is old and feeble and retention has existed for a long time, so that the bladder is almost or quite atonic, caution should be exercised in withdrawing the urine, as the sudden removal of a long-standing pressure may induce an attack of syncope. If any signs of syncope should appear, the catheter should be withdrawn and again passed at a later period.

Renal congestion or actual hæmorrhage may result from the sudden withdrawal of a large quantity of retained urine.

If all attempts at catheterisation fail, further treatment must at once be adopted. If the patient be strong and otherwise healthy he may be placed for half-an-hour in a hot hip bath, and a full dose of opium administered. In some cases the patient will be able to pass water whilst in the bath; or after removal from the bath another attempt at catheterisation may succeed. When, however, the patient is old and feeble, as is very frequently the case in retention from senile hypertrophy of the prostate, this treatment should not be adopted; but he should be put to bed, and hot fomentations to the hypogastrium and perinæum applied. Opium in these cases is often dangerous, on account of the damaged state of the kidneys.

If these means fail, recourse must be had to some operative procedure. If the case is one of organic stricture, and the necessary materials and assistance are at hand, the patient may at once be submitted to perinæal section, and the operation of Cock, with division of the stricture from behind forwards, or Wheelhouse's operation performed. By these methods the retention and stricture are treated at the same time. In cases of prostatic hypertrophy, and in other cases where such radical measures are undesirable on account of the patient's condition, or impossible from absence of the

necessary aid and appliances, relief should be sought by the puncture of the bladder above the pubes, either with a small trochar and cannula, or by means of the aspirator. Puncture of the bladder through the rectum is a dangerous and obsolete practice, and should never be performed. One puncture of the bladder may suffice, and the patient either be enabled to pass water voluntarily afterwards, or a catheter may be successfully introduced after a few hours' rest. In some cases, especially in those of prostatic hypertrophy, the puncture may need to be repeated two or three times, or even oftener, before a catheter can be successfully passed.

It must be remembered that there is a slight risk of urinary extravasation after puncture of the bladder, and each fresh puncture increases the risk; so that if, in cases of prostatic hypertrophy, a catheter cannot be passed after three or four punctures of the bladder, combined with rest in bed, hot fomentations, and constitutional treatment, a supra-pubic incision into the bladder should be made, and the bladder thus drained for a period. By this method the congestion about the neck of the bladder, which will have been keeping up the trouble, will subside, and the prostatic hypertrophy will be considerably diminished.

In cases of stricture, after relief has been given to the retention, attention should at once be paid to the treatment of the stricture itself, and one of the methods already described (pages 882-886) adopted.

Hysterical retention of urine must be treated on the same moral and constitutional lines as are employed in the treatment of hysteria elsewhere.

The complications that may follow on retention of urine, such as urethral fever, uræmia, and various forms of nephritis, are treated of under articles devoted to these affections.

FISTULA OF THE URETHRA.

There are three varieties of urethral fistulæ namely:—(1) The penile; (2) the scrotal and perinæal; and (3) the rectal. They differ from each other in origin, in anatomical characters, and in treatment.

1. **The urethro-penile.** *Ætiology.*—Penile fistulæ as a result of urethral abscess are rare. They are sometimes formed in the course of a chronic gleet by ulceration spreading deeply from a follicle of the mucous membrane. Another cause is progressive and deep ulceration occurring in some cases of soft chancres, and penile fistulæ may occur in the course of epithelioma of the penis.

Pathology.—These fistulæ are short and direct. The corpus spongiosum in the neighbourhood of the fistula generally atrophies. When due to cancer, cauliflower excrescences often surround and surmount the orifice. In other cases the external orifice is depressed, whilst the internal is usually funnel-shaped.

Symptoms.—A variable amount of urine or semen escapes at the fistula, and the dribbling is apt to give rise to excoriations or

erythema of the scrotum and penis. A little pus often escapes with the urine, or independently of micturition. The fistula may close over for a long interval, and then break open and discharge a little pus for a few days, and then close again for a varying interval: the same process may be repeated again and again. A sharp attack of urinary fever may attend the reopenings of the fistula. The atrophy of the corpus spongiosum may be sufficient to cause slight arching of the penis during erection.

Prognosis.—The prognosis is only serious from the point of view of the difficulty in getting these fistulæ to heal in spite of the most varied and most careful treatment. There is no fear of secondary disease in the bladder or higher urinary organs. The rigors and feverish attacks that attend in some cases the patent stages of these fistulæ are not dangerous to life, though trying to the strength, health, and convenience of the patients.

Treatment.—For the very narrow fistulæ, cauterisation with a fine wire heated to a white heat, or the point of a thermo-cautery, may succeed, but its results are quite uncertain. In the majority of fistulæ, a plastic operation, whereby “freshened” surfaces are held together by sutures, is the best plan to adopt. Several methods are described. After any of these operations, a catheter should be retained in the bladder so as to protect the sutures from contact with urine.

In very troublesome cases, where much urine escapes through the fistula, and other measures have failed, an opening should be made in the membranous urethra, and the bladder drained through it, during the process of healing after an operation on the fistula.

2. Urethro-scrotal and urethro-perineal fistula.—These are nearly always the result of urinary abscesses formed in association with stricture. Traumatic ruptures sometimes terminate in fistulæ, as do surgical operations on the perineal urethra or on the bladder. Fistulæ from surgical operations or traumatic ruptures are best guarded against by accurate suture of the urethral walls.

Other causes are periurethral abscesses, which open both into the canal and through the skin. Suppuration of one of Cowper's glands, and also breaking down tuberculous and gummatous deposits in the perineum, are illustrations of this class. Prostatic abscesses, opening externally, are also occasional causes, as is also carcinoma of the deep urethra, prostate, or bladder.

Pathological anatomy.—The internal orifice is commonly single, and even if the membranous or prostatic urethra is tunnelled by several tracts, they communicate with a single opening into the canal. But, as a rule, there are more than one, and very often there are several cutaneous openings, and these may be widely separated and far away from the perineum. They may burrow through the pelvis and open on the buttocks, or near the trochanters, through the great sacro-sciatic foramen; or they may come to the surface near the anus, in the groins, loins, or hypogastrium.

These sinuses are sometimes coated with a layer of the urinary

salts, chiefly phosphates; they are sometimes the resting-places of calculi from the kidney, bladder, or prostate, which increase *in situ* by the deposition of salts from the urine as it flows over them.

Symptoms and diagnosis.—The history is usually sufficiently characteristic. The amount of urinary leakage varies, but even when very little, the surrounding parts are moist and excoriated or erythematous. A probe can be sometimes passed along a fistula and made to touch a metallic sound in the urethra and thus clinch the diagnosis, but a negative result does not in any way disprove the connection of the fistula with the urethra. A fistula in ano, with only an external orifice far forwards in the perinæum, and complicated by a gleet and a stricture, may make the case very puzzling; but the history, and laying open the fistula, will clear up the diagnosis. Perinæal fistulæ from diseased bone will be diagnosed by the probe, and the history and other signs of bone disease.

Treatment.—The treatment consists in dividing the stricture of the urethra by an external urethrotomy, following up and laying open the branches of the fistulæ; scraping their surfaces or cutting away their cord-like walls, and thoroughly asepticising the tissues by the liberal application of strong carbolic acid, or of iodoform, freely rubbed into the surfaces. Of course, any calculus should be extracted, and if the sinus tracts are lined by earthy salts, they should be well rubbed, or scraped with a blunt scoop.

The treatment by retention of a catheter in the bladder is disappointing, though in some cases successful. Injections are of little value, especially in chronic cases; but the thermo-cautery has been successful in a few cases.

3. Urethro-rectal fistulæ.—They are sometimes traumatic, having been made at the time of, or following, lithotomy. Rarely, they have resulted from the ulceration of foreign bodies, either from the urethra into the rectum, or *vice versâ*. Suppuration in or about the prostate is, in the great majority of cases, the cause of these fistulæ. The double opening of periprostatic abscesses into the rectum and into the urethra is very common.

The urethral orifice is single, and generally in the prostatic urethra on one side of the verumontanum. It is rarely in the membranous urethra. As the urethral orifice is almost always situated on a higher level than the rectal, it is much easier for the urine to escape into the rectum than for fæces to get into the urethra. The course of the fistula is usually sinuous and branched, and its walls are indurated.

The rectal opening is just above the sphincter; it is sometimes masked by a tongue of mucous membrane, and, though sometimes small, is in other cases wide and easily detected.

These fistulæ sometimes open by a branch sinus in the perinæum, or in the groin, or in the thigh.

Symptoms and diagnosis.—Urine escapes into the rectum and accumulates above the sphincter ani, and is discharged like the fæces. The mucous membrane is not always very tolerant of urine;

and if the latter be septic, an inflammation of the mucous membrane of the bowel of a dysenteric character may be excited.

In some cases there is a frequent and considerable escape of semen into the bowel quite independent of erections, as well as of ejaculation at the time of coitus.

Fluid fecal matter may get into the urethra and be discharged at the meatus, or into the bladder, and set up acute cystitis. A patient under my care some years ago with cancer of the rectum used to pass rectal gas when micturating, and bubbles of air emerged from the urethra with the urine, bursting as they dropped on to the ground or in the vessel. The poor fellow described these as being like to round clear "bladders" or berries.

The diagnosis is clear if rectal gas or fecal matter passes per urethram; but, if this is not the case, a small quantity of urine passed into the rectum is likely to be overlooked. An examination with the finger in the rectum and a sound in the bladder will often discover the cause of the fistula, as well as reveal the existence of the rectal orifice. If the orifice is obscured by a fold of mucous membrane, it may be detected at once by injecting coloured fluid down the urethra, or by getting the patient to micturate whilst the surgeon inspects the rectum by the aid of the speculum.

Treatment and prognosis.—The treatment consists in endeavouring to keep the fistula dry of urine by drawing it off through a catheter retained in the bladder. Thompson cured a young man in six weeks by insisting on his passing urine whilst lying on his stomach, and never in any other position. In one very severe case I drained the bladder by supra-pubic cystotomy, with improvement, after fruitless trial of perineal section and erosion of fistulæ at another hospital. Some cases in which the fistulæ arise from a prostatic abscess heal spontaneously after several weeks of suitable treatment.

It should be an object to keep the rectum clean by daily washing it out with boracic or weak mercuric lotion. When the fistulous tract is hard and callous, it should be slit open and scraped, or cauterised, and any bands of callous fibrous tissue between the rectum and bladder, or prostate, should be divided.

Urethral fistulæ that open externally through the abdominal walls.—These may result from extravasation of urine in one of two directions or in both. From stricture or rupture of the urethra, or occasionally after lithotomy, the urine may find its way behind the triangular ligament into the pelvic cellular tissue; and, exciting suppuration there, matter may point above Poupart's ligament. Or, again, the urine may, in other cases, course in front of the triangular ligament, and, creeping under the skin of the abdomen, may travel as high as the umbilicus. In such cases a fistula may form in the groin, or elsewhere upon the front or side of the abdomen.

Treatment.—No general rules can be laid down, but enough has been said to show that the cause of the fistula must be ascertained,

and the treatment directed accordingly. One thing will always be requisite, viz. to establish a free and, if possible, natural channel for the escape of urine. Thus, if stricture exists, it must be treated; if a foreign body is in the bladder it must be taken away. All causes of inflammation around the bladder must be removed, and, if extravasation has occurred, the prompt surgical treatment demanded for that emergency, and for the cause which has given rise to it, must be at once brought into effect.

TUMOURS OF THE URETHRA.

Papillomata, or vascular growths, excrescences, or vegetations (as they are indifferently called), are often seen in the urethra of women, but are very rare in the male urethra.

When growing from the mucous membrane of the deeper parts of the urethra they cannot often be diagnosed except with the aid of the endoscope. As a rule, they cause little, if any, obstruction to micturition, although sometimes the symptoms of stricture are present. They cannot be felt with a sound. Sometimes they cause considerable hæmaturia, or the feeling as of a foreign body in the urethra; there is often a slight chronic urethral discharge recurring, or aggravated by slight causes, and sometimes cystitis is excited.

Their presence may be inferred if catheterisation, easy and unaccompanied by pain, causes free bleeding, or if a part of the growth is caught in the eye of a catheter and removed.

Mucous polypi.—Small polypi, like nasal mucous polypi, have several times been accidentally caught and removed from the male urethra in the eye of a catheter. They may be pedunculated or sessile, and are met with in every part of the urethra, although the favourite site is near the meatus. They vary in size from a hemp seed to a lentil or a pea, or larger, and are either single or multiple.

Treatment.—If one of these benign tumours should make its presence felt by discomfort in the urethra, by hæmorrhage, urethral discharge, or slight obstruction to micturition, it should be destroyed with the curette or nitrate of silver. If near the meatus, it can be seen and reached on separating the lips of the meatus. In many cases its exact location can be detected by the experienced surgeon by the slight catch or obstruction he meets with in searching the different parts of the urethral wall with a catheter or bougie.

If this does not succeed, the endoscope will often afford the necessary information.

Cysts of the urethra.—These are rare, but a few cases of retention cysts, formed in connection with the glands of the urethral mucous membrane, have been recorded.

Cystic tumours of Cowper's glands have also been described, but the diagnosis in some of these cases is doubtful.

Carcinoma of the urethra.—Primary cancer of the urethra is exceedingly rare, very difficult of diagnosis in its earlier phases, and almost hopelessly unfavourable for removal in its later. As an

extension from the penis, prostate, or bladder, it is not so very infrequent. It occurs in men past middle life, and most usually in those who have suffered from some previous urethral trouble, such as stricture. Pain and gradual increasing difficulty in micturition, with hæmaturia and the formation of a hard tumour around the urethra, are the prominent symptoms. As in other forms of malignant disease, these symptoms are accompanied by progressive emaciation. The original glands are enlarged.

Treatment.—This can be but palliative. Great comfort will be given by draining the bladder.

Malignant disease of Cowper's glands.—This is very rare. One or two isolated cases have been recorded.

Treatment.—Early and complete removal would be the treatment, but the operation, if delayed, may be extensive, or very complicated, or even impossible.

INJURIES AND DISEASES OF THE PROSTATE.

Injuries of the prostate.—From the protected position of the prostate behind the arch of the pubis, injuries to it are very rare.

Wounds from without inwards are inflicted on the gland occasionally in the old operation of puncture per rectum for retention of urine, and in lateral or median lithotomy; others from within outwards, as in false passages. Surgical wounds are more frequent than accidental ones, although the prostate is liable to lacerations and contusions in fractures of the pelvis, and may be punctured or lacerated by a foreign body introduced through the rectum, or may be impaled on a spike entering from the perinæum. Gunshot wounds are very rare.

Infiltration of urine and hæmorrhage are the two risks.

Infective phlebitis is not unlikely in an organ so richly vascularised.

Bleeding may be free and even alarming, either by way of the urethra or through the wound; or blood may flow back into the bladder, especially if the neck of the bladder shares in the injury.

Extravasation to some extent must occur if the prostatic urethra is involved, and may spread either in the deep or superficial perinæum, according as the deep perinæal fascia is wounded as well as the prostate, or not.

Wounds inflicted from the perinæum or rectum may cause violent hæmorrhage without damage to the urethra; and, in fractures of the pelvis, the gland may be much contused or pulped without the urethra being entered.

Incontinence occurs if the neck of the bladder is divided.

The ejaculatory ducts may be divided or otherwise damaged as they traverse the prostate, and may in consequence become subsequently obstructed.

Treatment.—This will depend on the amount of hæmorrhage

and the tendency, or otherwise, to extravasation of urine. A catheter retained in the bladder will allow of the wound, if in communication with the perinæum, being packed with iodoform gauze, or the lithotomy petticoat plug, or the expansion bag of Buckston Browne may answer better.

If hæmorrhage cannot be stopped by these means, or by the application of ice to the perinæum, rectum, and hypogastrium, or by the internal use of ergot of rye, a free incision made in a crescentic manner across the perinæum in front of the anus will probably enable the surgeon directly to control the bleeding vessels. If the wound is of the nature of an incised or incised punctured one, aseptic sutures should be introduced into the wounded parts; they may even be sufficient, when judiciously placed, completely to control bleeding. Sutures would be worse than useless in contused and contused lacerated wounds, as they might tend, by shutting in discharges, to promote sepsis.

Acute prostatitis and periprostatitis. Ætiology.—Acute prostatitis arises from various causes, direct and indirect. Of the direct causes much the most frequent are gonorrhœa and gleet, forming about 75 per cent. of the total number of cases. When due to gonorrhœa, the inflammation is most usual about the end of the second week. Other direct causes are injuries, inflammation extending from neighbouring organs, various direct irritants, such as caustics to the urethra, the internal administration of cantharides, the irritation set up by instrumentation, and the presence of calculi or foreign bodies in the prostate. Sedentary habits, habitual constipation, and excessive coitus have been ascribed as rare causes by various authors. The so-called indirect causes are cold, sitting on iron or stone seats, or on wet grass or damp cushions, and the infective diseases; but it is doubtful if cold and many of the above-mentioned direct causes have ever produced prostatitis apart from a gonorrhœa or gleet. In a few cases no satisfactory origin of the inflammation can be assigned.

Acute periprostatitis, or inflammation of the cellular tissue which surrounds the prostate between the rectum and the deep triangular ligament, is most frequently seen as an accompaniment of, or extension from, inflammation of the prostate itself. Occasionally it occurs independently of the prostate, and is then secondary to inflammation of the rectum, bladder, or vesiculæ seminales.

Pathological anatomy.—The relative share in the inflammation taken by the prostate and the periprosthetic cellular tissue differs in each case. Sometimes the inflammation is periprosthetic at the outset, the prostate being but little inflamed, or *vice versâ*; in other patients, on the contrary, the inflammation has, throughout the disease, affected the prostate and surrounding cellular tissue equally.

Like all acute inflammations elsewhere, prostatitis and periprostatitis may end in suppuration, producing a prostatic or periprosthetic abscess. The latter is always situated behind the

prostate, and may often attain large size. Tortuous and chronic fistulæ may follow.

In the early and middle periods the prostate is much swollen, the prostatic venous plexus loaded with blood, and the urethral mucous membrane is somewhat congested. On section, a reddish, turbid fluid exudes, composed of a mixture of blood, serum, and the prostatic secretion. A little later this fluid contains pus, and the gland ducts, distended with pus, may be seen as minute whitish-yellow spots. Still later these pus spots increase in number and size and coalesce. Sometimes hæmorrhages or little masses of gangrenous tissue are found in the pus.

Symptoms.—The symptoms caused by these affections are very similar, and consist at first of a sensation of weight and fulness in the perinæum and some pain at the neck of the bladder. Micturition is more frequent, and is painful, especially towards the end of the act. There is rectal tenesmus. The pain increases and becomes throbbing, and is felt in an agonising degree when urine comes in contact with the urethra and the sphincter vesicæ is in action. The perinæum is tender and hot. Defæcation is very painful, and the anus is swollen and prominent, and large piles may form. At length there is retention, and the catheter has to be used, causing alarm and intense physical suffering. On introducing the finger into the rectum great pain is caused, and the bowel is felt to be tumid, soft, and very hot; large arteries are felt throbbing in the wall of the bowel. In prostatitis the outline of the prostate is very distinct, and the gland itself excessively tender and projecting against the bowel. In periprostatitis the outline of the gland is lost.

If suppuration has occurred the prostatic swelling as felt per rectum is soft, and, maybe, gives a sense of fluctuation, especially if the perinæum is at the same time pressed upon by the fingers of the other hand. If suppuration has not occurred, the gland feels tense and more or less hard. Pains in the loins, groins, and down the thighs are constantly experienced. Painful erections may occur. Fever, with its attendant constitutional symptoms, occurs at the outset of the local symptoms, and increases as the local changes heighten. Rigors most probably usher in the suppurative stage.

The fever is not necessarily very great. If it is prolonged with evening elevations, the probability is that there is pus pent up. If defervescence has not occurred by the eighth day suppuration is to be expected.

As the abscess ripens, one of two or three things may happen, if it is left to take its own course. It may burst into the urethra spontaneously, or it may be ruptured by the introduction of a catheter to relieve retention, or it may burst into the rectum, either directly or after having caused a "diffusion" abscess in the periprostatic tissue.

About 50 per cent. of all cases rupture into the urethra, and, if the exit for pus is free, abscesses which discharge in this direction generally get quickly well.

Periprostatic abscesses may burst into the rectum or membranous urethra, or may burrow along the urethra into the perinæum, or by the side of the rectum into the ischio-rectal fossa.

Diagnosis.—The sense of weight in the perinæum, the pain and straining at stool, the still greater pain in micturition, the retention of urine, and the detection of a large, hot, pulsating swelling against the front wall of the lower part of the rectum, together with the fever, and perhaps the attendant rigors, form a group of symptoms that ought at once to lead the practitioner to diagnose acute inflammation or abscess of the prostate or surrounding tissue.

From inflammation of the neck of the bladder acute prostatitis and periprostatitis can generally be diagnosed by digital examination per rectum. From acute inflammation of Cowper's glands the diagnosis can be made in the same way, and also by the fact that the greater tenderness and swelling are in the fore part of the perinæum, and rectal symptoms are generally absent in inflammation and abscess of Cowper's glands.

From stricture, hypertrophy of the prostate, and vesical calculus they are to be diagnosed by the sudden onset and acuteness of the symptoms, by the fever and other constitutional disturbances, and by the introduction of a sound.

Prognosis.—Recovery is the common termination when the abscess breaks into the urethra, or is opened in good time by the perinæum. So when it opens into the rectum before the matter accumulates largely, or is widely spread, a rapid cure often follows. When both urethra and rectum are penetrated, troublesome fistulæ, with the discharge of more or less, or the whole, of the urine by the anus, may follow. Exhaustion, hectic, septicæmia, or pyæmia are the most common causes of death.

Treatment.—From the outset of the symptoms hot fomentations to the perinæum, and the injection of hot water at frequent intervals into the rectum, should be employed, as they give much comfort by diminishing pain, mitigating the straining, and making micturition easier. Leeches to the perinæum, followed by a hot hip bath, relieve the congestion and swelling of the prostate, and stop much of the pulsating pain. Morphia (gr. $\frac{1}{2}$) combined with belladonna (gr. $\frac{1}{4}$) in a suppository is useful as a palliative of pain and spasms. So also are suppositories of cocaine (gr. 1), but they need more frequent repetition.

To relieve retention, a Jacques catheter, or a soft coudée if the Jacques will not pass, of No. 5 or No. 6 size, is the best instrument.

Frequent—i.e. every second day or so—digital examination of the prostate per rectum should be made, and as soon as pus is diagnosed, either by the softening of the prostate or fluctuation of the cellular tissue, or by the occurrence of increased tension, and perhaps of rigors, a free deep incision into the prostate, or periprostatic tissue, as the case may be, should be made from the raphe of the perinæum.

It is only when an abscess has so far worked its way towards

the rectum that it is almost through the rectal wall that it should be opened, or be allowed to open spontaneously in this direction. Even when far advanced towards the rectal wall, the pus may be successfully diverted by the perineal incision. Very serious hæmorrhage will follow an incision through the rectal wall, unless care is taken to avoid the dilated and forcibly pulsating arteries in the

In some cases that have spontaneously discharged into the urethra, no improvement follows until a free incision in the perineum has provided a ready and direct exit for the pus. I have found immediate benefit experienced, and a rapid cure effected, by the perineal incision where the drainage into the urethra is insufficient.

Chronic prostatitis.—This may occur as a sequel to acute prostatitis, or more frequently as a primary inflammation of the prostate not preceded or attended by any acute inflammatory symptoms. As a sequel to acute prostatitis, it is characterised by enlargement and induration of the organ, due to the unabsorbed inflammatory products of the acute stage, together with the history and symptoms of a subsiding or recent attack of acute inflammation. It may be mistaken for chronic senile hypertrophy of the prostate, but differs from the latter in that it affects the young, adult, and middle periods of life; it is almost always preceded by gonorrhœa or gleet, and is inflammatory in history, symptoms, and course. No active treatment is required beyond the internal administration of iodides, bromides, and saline aperients.

Primary chronic prostatitis. *Ætiology.*—Gonorrhœa is the chief and most frequent cause. The patients who suffer chiefly are the neurotic and the weakly. It affects men of this sort between the twentieth and fortieth year, when gonorrhœa is most prevalent, when the sexual fires are at their height, and when the genital functions most engage their attention.

Pathological anatomy.—The prostate may or may not be enlarged, but is a little less firm and somewhat more spongy than normal. On section, more fluid than usual issues from the tissue: it is of a dirty colour, and may be mixed with blood or pus. A few deposits of pus, from the size of pearl barley to the size of a pea, are scattered in the tissue, or there may be a chronic abscess of some considerable size communicating with the urethra. The mucous membrane of the prostatic urethra may be more vascular and the duct orifices dilated, or the surface may be coated in places with organised lymph. There may be one or more chronic periprostatic abscesses behind the prostate.

Symptoms.—A little muco-purulent discharge from the urethra, and a slight increase in the frequency of micturition, are the early symptoms; then is experienced a sensation of weight, and perhaps a little dull pain in the perineum, increased by standing, walking, or horse exercise, and by sexual intercourse. Aching about the groins, loins, and thighs is experienced, and on digital examination per rectum there is some increased sensitiveness on pressing the

prostate. On introducing a catheter or sound, increased sensitiveness, if not actual pain, is complained of, and the surgeon will often detect a creaking sensation like that of wet leather, just before the instrument enters the bladder. At the end of micturition there may be a little pain, or occasionally a drop or two of blood, and sometimes even more, so that vesical calculus will very likely be suspected. No cases simulate stone in the bladder so closely.

If a chronic abscess forms and bursts into the urethra, it may go on suppurating for a long time; urine gets into the abscess, keeps up irritation, and causes pain and decomposition, and in this manner the patient may be worn out or killed by septic infection or purulent phlebitis.

Diagnosis.—Primary chronic prostatitis is distinguished from senile hypertrophy by the age at which it occurs, the history of gonorrhœa, and the symptoms of inflammation. From prostatitis arising as a sequel of an acute inflammation, it is diagnosed by the facts that it is not preceded by acute prostatitis, and that it does not always, or perhaps often, cause enlargement of the organ. The question as to vesical calculus must in difficult cases be cleared up by the sound.

Treatment.—These cases require to be treated by counter-irritation with blistering fluid applied to the perinæum every five or six days. This treatment should be tried for six or seven weeks, and if symptoms continue unabated, a solution of nitrate of silver (commencing with 5 grs. to the ounce) or of chloride of zinc (1 gr. to the ounce) should be applied to the prostatic urethra by a perforated metal catheter carrying a piston and sponge, so that the fluid can be squeezed out when the catheter reaches the prostatic urethra. Rectal suppositories of iodoform (1 to 1½ gr.), and of ichthyol (4 to 5 grs.), have also been recommended. In certain chronic cases when the prostate is enlarged, but not painful, the cold douche to the perinæum may be tried daily. Constitutional treatment should not be neglected, and simple nutritious diets and tonics should be prescribed. Cod-liver oil, pure air, and a sea voyage, if it can be obtained, are highly valuable.

If a chronic abscess forms and goes on discharging a quantity of pus per urethram for a length of time, an aseptic incision from the perinæum should be made into it.

Prostatorrhœa.—This occurs occasionally in young men who have indulged in masturbation or undue sexual excitement, as well as in the habitually constipated who have to strain a good deal to expel the contents of the rectum.

Symptoms.—It is characterised by the discharge of a ropy mucus of a greyish white colour from the urethra at the end of micturition. The quantity varies from a few drops to a teaspoonful. It is sometimes attended with the presence in the urine of minute thread-like particles of inspissated mucus from the prostatic duct. It is due to a congestive state of the prostate gland, associated with dilatation of its follicles, but is not itself inflammatory, nor necessarily preceded by an inflammation of the prostate. It is attended by an

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extremely despondent state of mind, the patient often supposing that the discharge is seminal and that he is gradually becoming impotent.

Diagnosis.—It is to be distinguished from the discharge of chronic prostatitis or of folliculitis, as well as from ordinary gleet, by the discharge being entirely free from pus; from spermatorrhœa by the entire, or almost entire, absence of spermatozoa.

Prostatorrhœa is not necessarily preceded by gonorrhœa, being in fact most likely to affect those who have never had sexual connection.

Treatment.—The patient should be mentally reassured, and his fears should be removed by reasoning or ridicule. His mind should be healthily occupied. A nutritious but unstimulating diet should be taken. Tonics, especially quinine, strychnia, cod-liver oil, and perhaps iron, should be prescribed, and the bowels should be kept freely and regularly open. If he sleeps badly, or is troubled by lascivious dreams, a draught of bromide of potassium and a little tincture of belladonna, or a pill of camphor and henbane, should be taken at night. The cold hip-bath night and morning, or the cold douche to the perinæum, is of much importance in remedying the dilated condition of the follicles and the general congestion of the gland to which the discharge is attributable.

Senile hypertrophy of the prostate. **Etiology.**—Very little is known. Very many predisposing causes have been ascribed, such as syphilis, rheumatism, gout, vesical calculus, urethral stricture, sexual excesses, and engorgements of the hæmorrhoidal and prostatic

veins; but proof is wanting that any of them act as causes beyond tending to an increased determination of blood to the part. One fact can, however, be definitely stated, namely, that inflammation is certainly not one of the causes. These enlargements of the prostate never appear except in advanced years. They do not exist during the period of greatest functional vigour of the gland, nor is their occurrence coincident with, or immediately subsequent to, the greatest and most prolonged sexual excesses. They are, therefore, not like hypertrophy in general, and have no analogy, for instance, with hypertrophy of the kidney. Neither are they true hypertrophy of the gland in another sense, for in the great majority of instances



Fig. 895.—Hypertrophy of the Prostate.

the component tissues of the prostate are not all increased—certainly not all increased so as to preserve their relative proportions. Neither as a glandular nor as a muscular organ are they instances of hypertrophy, for it is neither the glandular nor the muscular tissue of the prostate that is commonly most developed (Fig. 895).

The probable cause of these enlargements, as of the similar enlargements of the uterus—the only organ of the body like the prostate, both in the nature and arrangement of its component tissues—is a special proclivity or tendency of its structure, which may be, perhaps, brought into action by anything which induces an active determination of blood to these organs or their immediate vicinity.

Pathological anatomy.—No new structures whatever are formed in any of these “chronic enlargements of elderly men.” They consist simply of an augmentation of the normal elements of the gland, not necessarily, however, in the same relative proportions, nor arranged in the manner of the normal prostate.

In the majority of cases the connective tissue of the gland is the part most concerned in the hypertrophy, the glandular and muscular elements taking little or no share. In a few instances there is a general hypertrophy of all the tissues of the organ, and very rarely the glandular element is in excess. The gland attains the greatest size when

the enlargement is chiefly due to connective tissue hypertrophy. Very frequently, distinct localised tumours (Fig. 896), varying in size from a pea to a walnut, are formed. They may consist of glandular or stromal tissues, and may be embedded in the gland,

whence they are easily enucleated, or they may be pedunculated. They may occur singly or as multiple tumours (Fig. 897). Both the general enlargement and the tumour form may occur in the same case. The prostate may be uniformly enlarged, or one lobe may

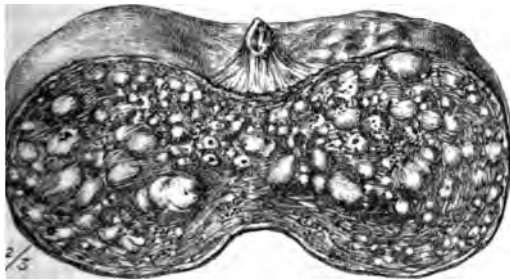


Fig. 897.—Transverse Section of Hypertrophied Prostate, showing prominent Fibro-myomatous Nodules. (After Orth.)

predominate. Most commonly the whole gland is enlarged pretty equally throughout, and when one portion predominates it is usually the central part.

The anatomical changes wrought by the enlarged prostate on the



Fig. 896.—Nodular Tumours of the Prostate. (Middlesex Hospital Museum.)

prostatic urethra and the neck of the bladder are clinically of importance. Obstruction is the commonest effect, but incontinence is occasional. Obstruction, sometimes amounting to actual retention, is brought about by the chink-like narrowing of the urethra produced by the increase of the lateral lobes, or by an actual barrier caused either by the elevation of the middle portion or by a small tumour at the vesical orifice. Incontinence, which is very rare, exists when the urethro-vesical orifice is widened out in a crescentic manner by the increase of the posterior central portion, so that the urine escapes between the sides of the central eminence and the lateral lobes. The prostatic urethra is lengthened so as to measure, in some extreme cases, three inches instead of one and a

quarter. It deviates to the right by enlargement of the left lobe alone, to the left by enlargement of the right lobe only, upwards by enlargement of the central portion, or it may be tortuous by the unequal enlargement of different portions of the gland.

The common effect upon the bladder is hypertrophy, with dilatation and saccululation (Fig. 898). The muscular trabeculae are thickened, whereas the mucous and peritoneal coats are thinned. Sacculi are formed by the bulging outwards of the mucous layer between the muscular trabe-

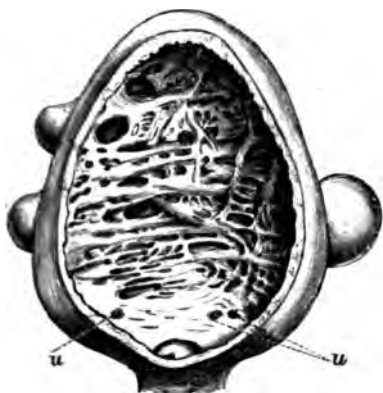


Fig. 898.—Hypertrophied and Sacculated Bladder.
(Middlesex Hospital Museum.)
u, Orifice of ureter double on left side.

culae. In some instances the bladder is found hypertrophied and contracted, more like the change which occurs from stricture; in other instances there is great dilatation, with little, if any, hypertrophy of muscular tissue. These differences depend partly on the suddenness and completeness of the obstruction caused by the enlarging prostate, and partly, perhaps chiefly, on the tone and physical strength of the individual. If the obstruction increases slowly, and the muscular power of the bladder is good, compensating efforts on the part of the bladder to overcome the obstruction will lead to hypertrophy, and only when this power is worn out will dilatation occur. If, on the other hand, the patient's powers are very enfeebled, dilatation will take place early, and there will be little or no hypertrophy of the vesical muscular tissue.

Symptoms.—The onset of the symptoms is very insidious, and when the enlargement does not specially affect the central lobe, it may have advanced to a considerable degree before anything abnormal in connection with micturition is observed. Usually, the first symptom is an undue frequency of micturition with some

difficulty in starting the stream, and with diminished power in projecting it. Increased effort to make the urine project clear of the trousers in some cases increases the difficulty, by bringing the bladder wall into closer contact with an enlarged middle lobe.

As the disease advances, micturition becomes more and more frequent, especially at night; and is not followed by a sense of complete relief. There is a feeling of fulness and weight in the perinæum and rectum not relieved by passing water. Actual pain is rarely, if ever, present. Expulsive efforts during micturition may cause inguinal hernia and prolapsus ani. Hæmorrhoids may appear, caused by the backward pressure of the enlarged gland; and erections from simple turgescence, unaccompanied by sexual desire, may annoy the patient. Hæmorrhage to a trifling degree sometimes occurs spontaneously after fatigue, exposure to cold, or excitement. Retention of urine is in some cases so complete that no urine whatever can be passed, and the patients are entirely dependent upon the catheter. In some instances complete retention occurs, but only for a time, the patient subsequently regaining some power of micturition as the prostate alters in shape and size.

The alteration in the urine must be noted. At first the bladder is unable completely to expel its contents, and a little residual urine is left behind after each act of micturition. As symptoms progress, the quantity of residual urine constantly increases, and the bladder becomes less and less capable of emptying itself, until at last a condition of incontinence from retention is set up, and almost continual dribbling of urine is the result. This may be partly brought about by distortion of the middle lobe of the prostate as mentioned above. The dribbling is most complained of at night when the vesical sphincter is relaxed in sleep. The incontinence may be followed by an attack of acute retention from some slight inflammation set up by cold or over-fatigue.

When the quantity of residual urine is small its decomposition is for a long time prevented by its constant admixture with the fresh secretion; yet at length changes occur. At first there is slightly offensive odour and some turbidity; the urine becomes neutral, then alkaline and ammoniacal, and acute cystitis is set up. In these circumstances, vesical calculi may arise and complicate and aggravate the prostatic symptoms. Moreover, acute cystitis, by interfering with the due nutrition of the bladder, will render it still less capable of coping with the obstruction. Later the ureters and renal pelvis become dilated, and secondary changes occur in them due to infection from the inflamed bladder. *Pari passu* with the renal changes, the general health suffers, rigors and attacks of fever occur, and uræmic poisoning, or septic infection and coma, bring about a fatal termination.

Diagnosis. — The increased frequency of micturition, the difficulty in starting the stream, the slow narrow flow which can only be projected a little way beyond the penis, and, perhaps, the dribbling of a few drops after the cessation of the expulsive

efforts, when occurring in an elderly man, are sufficient to excite our suspicion; and if on examination per rectum an enlargement of the organ is discovered, we have sufficient evidence for making a diagnosis. Our next step should be to ask the patient to void water. This he will do with the confident assurance at the end of the act that he has emptied his bladder. If now a soft catheter be at once passed, the surgeon will in all probability draw off an ounce or two, or it

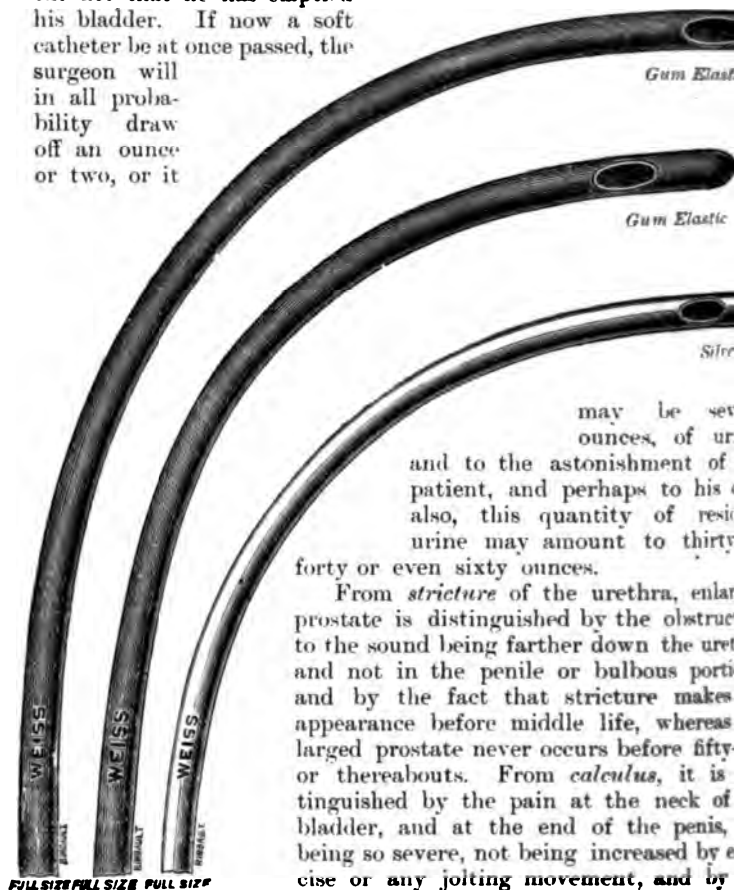


Fig. 899.—Prostatic Catheters. (Weiss.)

may be several ounces, of urine, and to the astonishment of the patient, and perhaps to his also, this quantity of residual urine may amount to thirty

forty or even sixty ounces. From stricture of the urethra, enlarged prostate is distinguished by the obstruction to the sound being farther down the urethra and not in the penile or bulbous portion, and by the fact that stricture makes its appearance before middle life, whereas enlarged prostate never occurs before fifty or thereabouts. From calculus, it is distinguished by the pain at the neck of the bladder, and at the end of the penis, being so severe, not being increased by exercise or any jolting movement, and by the absence of any sensation elicited by sound. The bladder with a short-beaked sound. Hæmorrhage is much more frequent

in calculus than with enlarged prostate, especially after exercise. It must be borne in mind that phosphatic calculus is often formed as the result of the changes in the urine induced by the retention caused by enlarged prostate.

From vesical tumours, the absence of frequent, severe, sudden, unprovoked, and intermittent hæmaturia extending often over months

years, together with the changes in micturition above described, and the detection of an enlarged prostate per rectum, will aid the diagnosis. Bleeding from papilloma may be excited by the gentlest catheterism. Frequent microscopic examinations of the urine will probably detect fragments of the tumour. Cancer of the prostate or of the base of the bladder gives rise to irregular-shaped, hard tumours as felt per rectum, not to enlargements of the smooth, uniform, and typically-shaped outline of enlarged prostate; moreover, the rate of growth of the swelling, and of the development of the symptoms, the greater pain and more abundant hæmaturia, the rapidly-failing health, and the emaciation of the patient, and, in all probability, the enlargement of the inguinal lymphatic glands, will point to malignant new growth in distinction to non-malignant simple hypertrophy of the prostate.

Atony and paralysis of the bladder may give rise to many of the symptoms of enlarged prostate, but the easy passage of a catheter, the feeble flow of urine, and the absence of any prostatic enlargement to be felt per rectum, will clear up the question at once.

Treatment.—The most essential thing is the early recognition of the fact that the patient has an enlarged prostate which prevents him from completely emptying his bladder, and then inducing him at once to enter upon what is called *catheter life*. If he acquiesces he will certainly promote his comfort, save himself from many distressing complications of his disease, and, in all probability, retard the rate of increase in the gland, and add considerably to his chances of prolonged life. It must be remembered that there are a few cases of enlarged prostate where the enlargement is chiefly at the posterior part of the gland, and the urethral portion but little affected. Such patients can always empty their bladder, but suffer from increased frequency of micturition, dragging and aching in the perinæum, rectal tenesmus, and hæmorrhoids. In these cases catheterism will give little or no relief, and treatment consists in strict dietetic régime, and the regular performance of digestive functions. For these cases perinæal prostatectomy will be found to give relief.

In the vast majority of cases, however, the chief troubles and dangers arise from urinary obstruction.

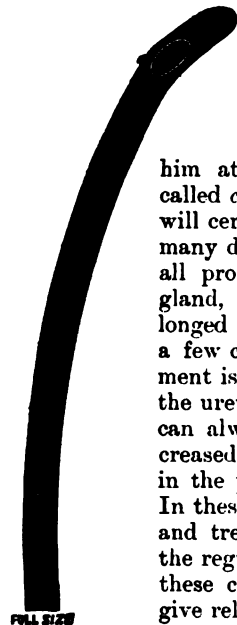


Fig. 901.—Bicaudé Catheter. (Weiss.)



Fig. 900.—Coude Catheter. (Weiss.)

For these patients, the regular use of the catheter is their sheet-anchor. How often the catheter will be required will depend upon the amount of residual urine. If there be only two or three ounces, it will suffice to empty the bladder completely every second or third day; if more, the catheter should be passed every day.

The best time to pass the instrument is at night on going to bed, so that the bladder may be in repose, and the patient too, for several hours. If complete retention first brings the patient under surgical observation, and there are many ounces (thirty or upwards) of urine in the bladder, it is best not to draw off all the urine at once, but to remove two-thirds of it and leave the rest to be removed in two, three, or four hours.

Every man with enlarged prostate should avoid high feeding, excess in alcohol, sexual excitement, chills, damp, fatigue, and horse exercise. During catheter life there is always a risk of inducing a cystitis. Patients should be warned as to the necessity for maintaining the perfect cleanliness of their catheters. If the catheter gets rough or cracked, it should be at once destroyed.

For acute retention supra-pubic aspiration is the immediate remedy. The aspirator may be needed two or three times.

In cases in which retention has become *permanent*, and catheterism is very painful, or excites urethritis; or when an instrument retained in the bladder quickly becomes coated with phosphates from alkaline urine, the bladder should be tapped and drained above the pubes.

Supra-pubic cystotomy is the most suitable operation for those very severe and painful cases of large prostate for which a *permanent* drain for the bladder is required. But if the object be to drain the bladder *temporarily* for the sake of giving rest to the parts, then the perineal incision, followed by the dilatation of the prostatic urethra with the finger, and the retention of an indiarubber tube for ten days or a fortnight, is very efficacious, and is a better and more convenient drainage and a less serious operation than hypogastric cystotomy.

Radical treatment.—For a radical cure two things are necessary—namely, the removal of the prostatic obstruction and the preservation of an efficient degree of expulsive power in the bladder. Many plans have been suggested to attain these objects, but most have proved failures. Excision of the prostate, or such portions of it as cause the obstruction, is called prostatectomy, and is performed by opening the bladder either above the pubes or through the perineum, or through the perineum without opening either bladder or rectum, and then removing the obstruction with the *écraseur*, the knife, the finger, or with a specially-devised prostatectome. Prostatectomy has hitherto been attended with large mortality, and though successful in some cases in restoring voluntary micturition and relief of symptoms, has failed much more often to effect anything in the shape of a radical cure. It therefore ought not to be performed in any case which is amenable to catheter treatment, or temporary drainage.

of the bladder. Other methods are on their trial in the treatment of very bad cases. These are galvano-cauterisation, castration, and the application of ligatures to the internal iliac arteries. Professor White, of Philadelphia, bearing in mind the analogy between uterine fibro-myomata and prostatic overgrowth, was the first who suggested castration as likely to have the same effect on prostatic hypertrophy that oöphorectomy has upon the uterine tumours. If one-half of the prostate is enlarged the corresponding testis is to be removed, and if the whole prostate is involved both testes should be excised. This treatment has hitherto been followed by a fair amount of success, the prostate in several cases having more or less rapidly shrivelled after the operation, and the symptoms correspondingly relieved. On the other hand, a good many cases have been reported in which no such result followed castration, the prostate remaining unaffected either one way or the other. Sufficient time has not yet elapsed for positive assertions as to the value of the operation. M. Guyon and Harrison have practised with success the excision of a portion of the vas deferens. Harrison had previously ligatured the vas deferens with benefit to his patient.

Prostatic calculi and concretions.—It is very common to meet, in the prostates of elderly men, with a number of small blackish or brownish bodies about the size of poppy-seeds. They are most frequent just within the orifices of the prostatic ducts, and barely covered with mucous membrane; but they occur also, but of smaller size, dispersed throughout the gland. They are known as prostatic concretions, and are composed of purely organic matter derived from the prostatic secretion, and are not deposits from the urine, nor in any way due to bladder derangements. In their earliest stage they are microscopic and translucent, but as they grow they become dark in colour, lose their transparency, and earthy salts are precipitated on them. These salts are derived from the mucous glands of the prostate, and consist chiefly of phosphate of lime and a little carbonate of lime, and when the nuclei have become completely invested with an earthy deposit, they may be said to have ceased to be concretions and to have become calculi. A typical prostatic calculus is very hard, and of a white, fawn, or pale brown colour. When one has attained the size of a small shot or pea, it causes absorption of the walls of the follicle which secreted it; and thus many calculi, from many crypts, come to occupy a single space, cease to increase in size, and become faceted on their surfaces. There may be as many as two or three hundred of these calculi in one prostate, varying in size from a sago grain to a pea.

Symptoms.—There is often severe irritation at the neck of the bladder accompanied by pain, or some difficulty in passing water. Hæmaturia and urethral hæmorrhage are both apt to occur. The catheter or sound may give a creaking sensation as it passes over the prostatic urethra, and the same sensation may be experienced on digital examination per rectum. Occasionally a typical calculus is passed per urethram. In some cases calculi have given rise to

abscess in the prostate; in others they have ulcerated into the tissues about the prostate, and urinary fistulae have resulted.

Treatment.—This consists in extracting the calculus or calculi, if possible, with urethral forceps, in the eye of a catheter, or by the lithotrite, after pushing the calculus back into the bladder; and if this cannot be done, or the calculi are too numerous or too large, a median perineal incision should be made into the membranous urethra and the calculi extracted through the wound. Care should be taken to do as little damage to the pulp of the prostate as possible, for fear of incontinence following from the shrinking and loss of the gland substance.

Calculi of extra-prostatic origin.—Prostatic calculi of urinary origin are formed in the prostate occasionally when, owing to ulceration of the floor of the prostatic urethra, the urine gains entrance into the gland, and the salts of the urine are deposited amongst the tissues of the organ.

The symptoms and treatment of these calculi are the same as those of concretions and calculi of intra-prostatic origin.

Cysts of the prostate. Retention cysts.—Two varieties have been described as occurring in the prostate. (1) Retention cysts due to the obstruction and closure of an excretory duct of a prostatic follicle; and (2) retention cysts caused by obstruction and closure of the orifice of the sinus pocularis. Except when they attain to a moderate size, and not always then even, the retention cysts offer no clinical histories, and afford scarcely any interest other than that of a pathological character.

Hydatid cysts.—These cysts are not strictly prostatic in origin, but are found occupying the tissue behind the bladder in the region of the prostate between it and the rectum. Their exact anatomical relations are a matter of dispute. In some cases the cyst has apparently had an intra-peritoneal origin, whilst in others the growth has been extra-peritoneal.

Symptoms.—In many of the cases retention of urine has been the symptom that has drawn attention to the presence of the cyst. It has then been discovered that a catheter of ordinary length has not reached the bladder, that the bladder is more or less displaced out of the pelvis, and that a large elastic tumour is felt per rectum in the situation of the prostate and bladder. Some difficulty in, or obstruction to, defecation, or tenesmus the result of pressure upon the rectum, may be complained of. When the tumour is large and presses firmly against the brim of the pelvis, one or both ureters may be obstructed, and hydronephrosis may be the result. In the same way, pressure upon the blood-vessels and nerves as they pass through the pelvis may cause coldness, numbness, œdema, or partial paralysis of the lower extremities. In some cases there has been dysuria, or the symptoms of stricture of the urethra, increasing for months or years. In others, the tumour has been tapped per rectum, and then diagnosed by the characters of the fluid.

Diagnosis. The clinical history will serve to exclude prostatic

abscess; but if the hydatid tumour be small, and yet lying in contact with the rectum, it may be difficult, except it fluctuates, to distinguish it from the prostate gland. If in addition to the swelling per rectum there is any elastic prominence of the perinæum, if the recto-vesical pouch of peritoneum is obliterated, or if a long catheter cannot draw off urine, and there is a well-defined, dull and painful tumour felt in the abdomen, there will be good ground for concluding that the small swelling in front of the rectum is part of a large tumour, and not the prostate.

Treatment.—The best treatment is to lay the cyst freely open through the perinæum by a crescentic incision in front of the anus, and then to clear out the contents and as much of the cyst wall as will peel easily away without provoking hæmorrhage. In some cases this proceeding is urgently needed to relieve the agony of acute retention, and to save the bladder from bursting. When the cyst is large, and ascends above the brim of the true pelvis, the abdominal instead of the perinæal route has sometimes to be employed. If laparotomy be adopted, great care may be needed to avoid opening the urinary bladder instead of the hydatid cyst.

Tuberculous disease of the prostate.—This affection occurs most frequently during the time of greatest sexual activity—that is, between twenty and forty. As a primary disease it is not common, and other organs are usually also affected. A gleet of long standing, affecting the deep urethra in a person predisposed by heredity to tuberculosis, is a common cause of tubercle of the prostate.

As a secondary disease it occurs as an extension from some other part of the genito-urinary apparatus, such as testis, kidney, or bladder, or as secondary to tuberculous disease of the lungs, peritoneum, or bone.

Pathological anatomy.—This does not differ in any way from the morbid anatomy of tubercle elsewhere. The prostate increases in size, but not greatly nor uniformly, and much of the increase is often due, not to the tuberculous masses, but to inflammatory œdema. As the tuberculous masses increase towards the mucous membrane, ulcers, without any tendency to heal, form in the prostatic urethra. These ulcers become sources of septic infection and urinary extravasation. Some of the softening, cheesy masses may discharge in this direction and leave a cavity, which goes on secreting pus and discharging it into the urethra or bladder. In some cases sclerosis of the infected tissue occurs, and the gland atrophies. If the disease is allowed to run its course, urinary fistulæ may form and open into the rectum or perinæum.

Symptoms.—These are not characteristic, and the disease may be present for a long time without being detected, especially if, as is most commonly the case, it affects the outer or peripheral parts of the gland only. The patient may complain of a weight in the perinæum, of some rectal tenesmus, or pain when at stool, but he probably comes under treatment on account of an urethral discharge, a lump in the epididymis, or an attack of cystitis. On digital examination per

rectum the prostate is found enlarged in part or throughout; or— it may present nodules; or a soft, flaccid spot, due to an abscess.

If the disease affects the central part of the gland and involves the urethra, the symptoms are those of chronic inflammation of the deep urethra, attended by a discharge of muco-purulent fluid in which the bacilli of tubercle may be found; there is pain with frequency of passing water, especially when the disease encroaches on the neck of the bladder; there may be urethral hæmorrhage or some blood-stained strings of muco-pus discharged with, or just after, the urine; pains may be complained of in the thighs, loins, and groins; cystitis may occur; and if there should be any inflammatory œdema or congestion around or about the tuberculous deposits, complete retention of urine may supervene.

Prognosis and treatment.—The prognosis is the same as for tubercle elsewhere. If it is primary it may in some cases become arrested. As a secondary tuberculous infiltration the prognosis is merged in that of the primary disease.

The general treatment consists in attention to diet, exercise, fresh air, warm clothing, and regulated temperature; and in taking tonic medicines, cod-liver oil, and, if necessary, narcotic drugs in the shape of suppositories.

There should be as little use of instruments upon the urethra as possible; they cause great pain, irritate the prostate, aggravate the disease, and do nothing but harm.

No caustic or astringent applications to the deep urethra are of any use.

Surgical interference is sometimes justifiable when the lungs and kidneys are not affected, and the local disease is not too far advanced. It has taken the form, in some instances, of incising and scraping away the diseased parts of the prostate, either through a median, perineal, or crescentic wound. In other cases, fistulous tracts have been freely laid open, either by incision or the thermo-cautery, or a deliberately planned perineal incision has been made, and tuberculous masses have been scraped away and the cavity has been dressed with iodoform gauze.

Malignant disease of the prostate.—Malignant disease affects the prostate very rarely either as a primary or secondary disease. Secondary cancer of the prostate is even more rare than primary, and takes place commonly as an extension from the bladder, more rarely from rectal cancer, and occasionally in association with cancer of the stomach. It is commonly of the soft variety, but a few instances of hard carcinoma have been reported.

Epithelioma is unknown in the prostate, so far as I am aware. Melanotic deposit is said to have been found in two cases—one in a child, the other in an adult, associated with encephaloid of the prostate. Sarcoma has been found in a few instances in both the round- and spindle-celled varieties.

Malignant disease of the prostate chiefly affects individuals at the two extremes of life—that is, before the fifth year and after the

fifty-ninth. The progress of the disease is much more rapid in children than in adults, and the whole course of the disease in children does not usually extend over nine months. This rapid progress accounts for the absence of secondary deposits in other viscera, which is a noticeable feature in malignant disease of the prostate in children.

Pathological anatomy of carcinoma of the prostate.

—Few opportunities have been afforded for the study of the morbid anatomy of the disease in its earlier stages, as the gland is generally in great part destroyed at the time of death. The disease begins, as a rule, with one or more depôts in one of the lateral lobes. Very occasionally it commences as a general infiltration.

It grows slowly at first, but after a while it rapidly enlarges, and may form a large mass, either confined within the limits of the capsule of the prostate, or sprouting as a fungous excrescence into the tissues around.

The mucous membrane of the prostatic urethra is generally perforated at length by the growth, either in the way of fungus, or by ulceration followed by sloughing or breaking down, or occasionally by suppuration, of the cancer.

The glandular structures of the prostate are the primary seat of the disease, the stroma being only secondarily involved.

Symptoms.—Urethral hæmorrhage is the most certain and most constant symptom. It is frequent, easily provoked, and often severe. The blood may escape either unmixed with urine or during micturition. Pain is an uncertain symptom. At first it may not be more than that due to obstruction of the prostatic urethra. Later it becomes intense. On examination per rectum the prostate is found enlarged, hard, and nodular in outline, and may be tender to touch. In the later stages, as the tumour softens and breaks down, it becomes irregular in consistence and outline. The bladder may become invaded and acute cystitis be set up. The pelvic glands, and sometimes the inguinal glands, are enlarged, and there may be evidence of secondary deposits elsewhere. Together with these special symptoms there are also combined the ordinary symptoms of obstruction in the prostatic urethra, such as pain and frequency of micturition with inability to empty the bladder, and diminution of expulsive power. As in other forms of malignant disease, there is progressive emaciation.

Diagnosis.—Malignant disease must be distinguished from the acute and chronic inflammatory, and chronic non-inflammatory enlargements of the prostate. The hæmorrhage, pain, rapid growth, and emaciation and absence of fever, lasting too long for an acute inflammation, and progressing too quickly for a chronic affection, proclaim the nature of the disease. The history, with signs and symptoms of enlarged prostate will serve to distinguish it from primary malignant disease of the bladder and from vesical calculus. Tuberculous disease of the prostate occurs in young people and lacks the severe symptoms enumerated above.

Prognosis and treatment.—The termination is always fatal; the treatment is only palliative. For the relief of retention the soft catheter must be used, but with scrupulous gentleness; otherwise, and even despite all care, hæmorrhage is excited. Catheterism should be avoided as long as possible—this is, till retention makes it necessary.

Opium and subcutaneous injections of morphia must be liberally administered, if necessary, to relieve the patient's sufferings. Attempts at excision of the growth have met with little success, and are to be discouraged. If catheterism is necessary, but gives rise to great suffering, or if acute cystitis aggravates the patient's misery, much relief will be obtained by supra-pubic or perineal drainage of the bladder.

INJURIES AND DISEASES OF THE BLADDER.

CONGENITAL DEFECTS OF THE BLADDER.

The congenital defects of the bladder are absence, hernia, exstrophy, and supernumerary bladders.

Absence of the bladder.—Only a few instances are on record. When it occurs, the ureters open either into the urethra, the rectum, the vagina, or on the abdomen, generally in the median line.

Supernumerary bladders.—Most of the cases that have been recorded as supernumerary bladders have been either sacculated bladders or bladders bisected by a membranous partition.

A few cases of true multiple bladders have been recorded, notably that of a woman who had five bladders, five kidneys, and six ureters. Four of the ureters opened each into separate bladders, the other two into the largest bladder.

Hernia of the bladder or cystocele.—This may occur as a congenital defect or be acquired.

Congenital cystocele.—This is a rare condition. The same description as is given below for the acquired form is applicable to the congenital variety.

Acquired cystocele.—The bladder may be protruded in a hernial form when the linea alba is weak or when the front wall of the abdomen is partially or wholly deficient, in which latter case the cystocele will be of congenital origin.

Etiology and morbid anatomy.—Great protrusions are sometimes met with in the middle line at the scar of a laparotomy wound or of an abscess. Over-distension of the abdominal walls from ascites, pregnancy, fat followed by emaciation, or the flaccidity of age, are conditions that lend themselves to hernial protrusions of the bladder as of the other viscera. The inguinal, femoral, obturator, and ischiatic foramina have all been the site of cystoceles accompanied or unaccompanied by a portion of bowel or omentum.

Vaginal cystocele is by no means uncommon in fat, flabby

women who have borne several children, and in them it sometimes projects beyond the vulva.

The protruding part of the bladder is uncovered by peritoneum except when accompanied or preceded by an ordinary hernia of large size, or where a great portion of the bladder is involved.

Besides the weakened condition of the abdominal walls or vagina, or the easy patency of one of the natural openings in the parietes, two other conditions are requisite for cystocele—namely, a dilated bladder, due to frequent and considerable distension, and frequent straining efforts at micturition. As soon as the bladder has once escaped at a hernial protrusion it acquires a more or less sacculated or hour-glass form, and urine, by being constantly retained therein, at length decomposes, and may lead to ulceration, calculous formation, or sloughing.

Symptoms and diagnosis.—A cystocele increases with retention or accumulation of urine, and diminishes in size—though it may not quite empty, or become flaccid—by urinating or the use of the catheter. It may form a soft, flaccid, or a dull, tense, fluctuating swelling, according to the quantity of urine it contains. It is neither doughy, like an epiplocele, nor resonant, like an enterocele. If a cystocele becomes strangulated, the symptoms may simulate very closely a strangulated hernia; but, in addition, there will almost certainly be other symptoms special to the bladder, such as blood in the urine, painful and frequent micturition, and pain specially referred to the hypogastrium and neck of the bladder.

Treatment.—The pouch of bladder should be kept empty of urine, either by voluntary micturition or by the catheter and the application of a truss. If irreducible, an attempt should be made to return the protruding part, and close the opening of exit by an operation similar to the radical cure of hernia. If this is not feasible, or the patient declines an operation, a well-fitting, well-moulded truss and pad should be worn to prevent the protrusion from increasing. A vagino-cystocele should be treated by an operation for tightening and shortening the anterior vaginal wall.

Ectopion vesicæ or exstrophy of the bladder.—Ectopion vesicæ is characterised by a failure in development of the anterior wall of the bladder and of the abdominal wall in front of the bladder; whilst the posterior wall of the bladder projects at the hypogastrium, where it is continuous with the anterior abdominal parietes.

Ætiology.—This malformation is more frequent in boys than in girls in the proportion of eight or nine to one.

Its cause is still unknown, but the theory generally accepted is that it is due to an arrest in development of the anterior portion of the allantois as well as of the ventral lamellæ which form the abdominal walls.

Pathological anatomy.—Ectopion vesicæ appears as a florid

red body in the hypogastric, or hypogastric and pubic regions. In very young subjects it is not larger than a nut; in adults it is the size of an apple.

It is, in outline, irregularly oval or circular; in colour, florid red; and presents a moist mucous membrane which generally bulges more or less, like the rind of half an orange turned inside out; sometimes forms a depression; at others, presents two lateral prominences separated by a vertical groove. When of large size, it may be pedunculated. It expands during respiration and coughing, and can be partially reduced by compression. Gurgling is at times to be heard behind it. Its circumference is sharply defined and indurated, being formed by the aponeuroses of the abdominal parietes (Fig. 902).



Fig. 902.—Ectopion Vesicæ. The posterior Wall of the Bladder with the openings of the two Ureters is to be seen.

The surface bleeds readily, and is often painful; the lower part is always moister and more vascular than the upper, and there are upon it two small, round projections, the orifices of the ureters, and on watching them one sees urine flowing from them, not drop by drop, but by a sort of feeble and irregular ejaculation.

At the margin, the epidermis is continued insensibly into the epithelium of the mucous membrane, and little islands of it are situated on the mucous surface—in fact, there is a tendency for the epithelium to change into epidermis.

Around the ectopion the cutaneous surface is marked by irregular cicatrices which are considered to be relics of the allantois. Above the ectopion is a median depression, due to the want of the linea alba, as high as the umbilicus.

Below, the ectopion is continuous in the male with a rudimentary penis which is always in the condition of epispadias. The scrotum may be absent, and the testes are frequently retained in the inguinal canals. In the female there is a separation of the labia majora, of the two sides of the clitoris, and of the labia minora. In both sexes there is a wide separation of the pubic bones. By rectal examination, absence or ill-development of prostate and vesiculæ seminales may be made out. The sacrum is much projected forwards, thereby lessening the antero-posterior diameter of the pelvis. Nothing but a layer of cellular tissue, and not always that, separates the vesical mucous membrane from the peritoneal coat.

Symptoms.—Individuals with ectopion vesicæ may be otherwise well formed and robust; but most frequently they are thin, weakly, and constantly suffering, as the slightest friction from their linen inflames the vesical mucous membrane. Thus they often die from ascending inflammation ending in suppurative pyelo-nephritis.

As a result of the constant trickling of urine, these patients are always wet and in discomfort, and frequently affected with erythema, excoriations, erysipelas, or more deeply-seated inflammation of the skin and tissues around.

As a rule, sexual appetite is wanting, but in the female a few cases of conception have been recorded, with offspring naturally delivered.

Malformations of other organs and parts are frequently found with ectopion, especially those connected with the anus. Double inguinal hernia is very common. Ectopion is not incompatible with a long life.

Treatment.—Many appliances have been invented to collect the urine and to prevent the irritation of the sensitive mucous membrane of the bladder. They are not very successful in their object. The best are those designed by Earle, of London; Jurine, of Geneva; and Bonn, of Amsterdam. They consist essentially of a sort of cup, applied over the exstrophy, communicating by a tube with a reservoir fastened to the thigh, and may be provided with a valve at the top and a tube and tap below.

Many and ingenious operations have been devised to remedy this deformity. The results of these operations are only palliative, and only partially successful even to that extent. The reason of this is the absence of the vesical sphincter, which renders the patients unable to retain their urine after even the most successful operation. The dangers that attend the operations are purulent infection of the urinary mucous tract, hæmorrhage, erysipelas, and sloughing of the flaps. It must suffice here to mention the various plans that have been tried.

(1) The method most in vogue is what is known as the *auto-plastic* method, i.e. closure of the extroversion by means of cutaneous flaps, the epithelial surface of each flap lying next to the mucous membrane of the bladder. By this operation the escape of urine is limited to a single spot, where it can be controlled by a well-fitting urinal. Moreover, by this method the sensitive mucous membrane of the bladder is protected from the constant friction of the clothes. Some patients when they have reached puberty have suffered much irritation and distress from the growth of hair on the bladder side of the inverted flaps.

(2) Establishing a fistulous communication between the ureters and the rectum.

(3) Making a fistula between the bladder and the rectum. The mortality of these last two methods is 40 per cent. It has been found that the rectal mucous membrane, after a time, becomes fairly tolerant, and patients have been able to retain urine within the sphincter ani for a certain length of time. This method may be combined with

(4) Closing of the bladder by suturing its margins and approximating the symphysis pubis, which is represented in these cases by a band of fibrous tissue. Dubuis, Dupuytren, and, more recently, Trendelenburg and Passavant have sought to obtain a radical cure

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by bringing together the pubic bones and suturing the two sides of the extravasated bladder. For this purpose the division of ligamentous union at the sacro-iliac synchondroses has been formed in children before the fifth year of life with some measure of success.

(5) The removal by dissection, or the destruction of the muscular membrane of the bladder, except round the orifices of the ureters.

INORGANIC OR FUNCTIONAL INCONTINENCE OF URINE.

Incontinence of urine due to organic causes, such as retention from urethral obstruction, atony of the bladder, or injuries to the lumbar cord, are discussed elsewhere. Functional incontinence is almost entirely confined to childhood, with the exception of one class of cases, namely epileptics, in whom it may persist during life. The incontinence of epilepsy will not, however, be considered here.

Symptoms.—Incontinence in childhood is, in the majority of cases, limited to the night when the child is in bed and asleep, and is known as "*nocturnal incontinence*." The child habitually empties his bladder into the bed during sleep, and usually about the same time every night. During the day the urinary functions are performed normally.

In another class of cases, besides nocturnal incontinence there is much frequency of micturition in the daytime, and if immediate relief to the bladder is not given the child wets his clothes. This form is due to irritation of the spinal cord, intestines, or genito-urinary apparatus. Phimosis, contracted meatus, oxyluria, and lithæmia, and intestinal worms play an important rôle.

In yet another class there is habitual incontinence during both day and night. The bladder empties itself at intervals, without any consciousness on the part of the child. This form of incontinence is due to defective contractile power of the urethral sphincter, or to urethral insensibility. Such feebleness on the part of the sphincter may be congenital and due to malformation or excessively small size of the sphincter muscle, or to rudimentary or imperfect development of the external genital organs, such as hypospadias. In other cases it may be due to hysteria.

Prognosis.—All forms, except the epileptic, have a tendency to disappear at puberty. It is quite exceptional, if not altogether unknown, to meet with them after twenty-five years of age. Spontaneous cure sometimes unexpectedly follows an attack of fever or some other illness. In some cases, after the incontinence ceases, the individuals are obliged to pass water once or twice during the night, and this necessity may continue even throughout life. Many of these patients, however, get cured of their incontinence, or to enter upon some other nervous affection, such as spasm of the bladder, irritable bladder, or to become confirmed hypochondriacs.

abscess; but if the hydatid tumour be small, and yet lying in contact with the rectum, it may be difficult, except it fluctuates, to distinguish it from the prostate gland. If in addition to the swelling per rectum there is any elastic prominence of the perinæum, if the recto-vesical pouch of peritoneum is obliterated, or if a long catheter cannot draw off urine, and there is a well-defined, dull and painful tumour felt in the abdomen, there will be good ground for concluding that the small swelling in front of the rectum is part of a large tumour, and not the prostate.

Treatment.—The best treatment is to lay the cyst freely open through the perinæum by a crescentic incision in front of the anus, and then to clear out the contents and as much of the cyst wall as will peel easily away without provoking hæmorrhage. In some cases this proceeding is urgently needed to relieve the agony of acute retention, and to save the bladder from bursting. When the cyst is large, and ascends above the brim of the true pelvis, the abdominal instead of the perineal route has sometimes to be employed. If laparotomy be adopted, great care may be needed to avoid opening the urinary bladder instead of the hydatid cyst.

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rectum the prostate is found enlarged in part or throughout; or it may present nodules; or a soft, flaccid spot, due to an abscess.

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Prognosis and treatment.—The prognosis is the same as for tubercle elsewhere. If it is primary it may in some cases become arrested. As a secondary tuberculous infiltration the prognosis is merged in that of the primary disease.

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No caustic or astringent applications to the deep urethra are of any use.

Surgical interference is sometimes justifiable when the lungs and kidneys are not affected, and the local disease is not too far advanced. It has taken the form, in some instances, of incising and scraping away the diseased parts of the prostate, either through a median, perineal, or crescentic wound. In other cases, fistulous tracts have been freely laid open, either by incision or the thermo-cautery, or a deliberately planned perineal incision has been made, and tuberculous masses have been scraped away and the cavity has been dressed with iodoform gauze.

Malignant disease of the prostate.—Malignant disease affects the prostate very rarely either as a primary or secondary disease. Secondary cancer of the prostate is even more rare than primary, and takes place commonly as an extension from the bladder, more rarely from rectal cancer, and occasionally in association with cancer of the stomach. It is commonly of the soft variety, but a few instances of hard carcinoma have been reported.

Epithelioma is unknown in the prostate, so far as I am aware. Melanotic deposit is said to have been found in two cases—one in a child, the other in an adult, associated with encephaloid of the prostate. Sarcoma has been found in a few instances in both the round- and spindle-celled varieties.

Malignant disease of the prostate chiefly affects individuals at the two extremes of life—that is, before the fifth year and after the

dull in certain positions, and resonant when the patient lies with the same side upwards.

Failing other means, laparotomy with the view to actual inspection of the bladder is not only justifiable but right, and is the necessary step towards suturing the bladder if the wound should prove to be intra-peritoneal.

Prognosis.—Surgical wounds of the bladder, if recognised at the time of injury and appropriately treated by immediate suture, heal well, and can scarcely be said to prejudice the result of the operation in the course of which they have been inflicted.

Non-surgical intra-peritoneal wounds show a very high mortality which, however, has been much lessened by the employment of immediate sutures to the rent in the bladder wall. Extra-peritoneal wounds also show a high mortality. The greatest source of danger in both forms is extravasation of purulent urine, or urine that becomes purulent, into the peritoneal cavity or cellular tissue about the bladder. Other conditions that render the prognosis more unfavourable are hæmorrhage, acute peritonitis, acute cystitis, and damage to other viscera, blood-vessels, or pelvic bones, inflicted at the same time as the wound of the bladder.

Treatment.—In all cases of intra-peritoneal wounds, when the patient is seen before peritonitis has set in, laparotomy should, if the circumstances permit, be performed, the toilette of the peritoneum properly attended to, and the wound in the bladder closed by sutures. Care should be taken that the sutures should be applied close enough and carried sufficiently far beyond each extremity of the wound to prevent any escape of urine. The mucous membrane should not be included. The sutures should be applied by Lembert's method. The bladder should be drained for the first two or three days by catheter. Even when peritonitis has commenced, this should be the procedure of choice. But in country practice with only one, or perhaps no reliable assistant, this treatment cannot be wisely attempted, unless there are symptoms of internal hæmorrhage, when at all costs the abdomen must be opened and bleeding arrested. When this complication has not ensued, it will be best to trust to a catheter as a continuous drain, or to drain the bladder through a median or lateral perineal incision.

In extra-peritoneal wounds, if inflicted upon the front wall during the state of distension of the bladder, the edges of the wound should be brought together by sutures, and the bladder drained by a catheter. In wounds inflicted upon the posterior wall and base of the bladder, free drainage should be provided by means of a large catheter retained in the bladder; or if this is inefficient, by enlarging, if necessary, the wound, or by establishing a drain not only for the bladder but for the extra-vesical tissues as well, through a median or lateral perineal incision.

Hæmorrhage in these cases must be managed on the general principles applicable to all cases. In every event, the most scrupulous care should be used to keep the wound aseptic; and this is best

women who have borne several children, and in them it sometimes projects beyond the vulva.

The protruding part of the bladder is uncovered by peritoneum except when accompanied or preceded by an ordinary hernia of large size, or where a great portion of the bladder is involved.

Besides the weakened condition of the abdominal walls or vagina, or the easy patency of one of the natural openings in the parietes, two other conditions are requisite for cystocele—namely, a dilated bladder, due to frequent and considerable distension, and frequent straining efforts at micturition. As soon as the bladder has once escaped at a hernial protrusion it acquires a more or less sacculated or hour-glass form, and urine, by being constantly retained therein, at length decomposes, and may lead to ulceration, calculous formation, or sloughing.

Symptoms and diagnosis.—A cystocele increases with retention or accumulation of urine, and diminishes in size—though it may not quite empty, or become flaccid—by urinating or the use of the catheter. It may form a soft, flaccid, or a dull, tense, fluctuating swelling, according to the quantity of urine it contains. It is neither doughy, like an epiplocele, nor resonant, like an enterocele. If a cystocele becomes strangulated, the symptoms may simulate very closely a strangulated hernia; but, in addition, there will almost certainly be other symptoms special to the bladder, such as blood in the urine, painful and frequent micturition, and pain specially referred to the hypogastrium and neck of the bladder.

Treatment.—The pouch of bladder should be kept empty of urine, either by voluntary micturition or by the catheter and the application of a truss. If irreducible, an attempt should be made to return the protruding part, and close the opening of exit by an operation similar to the radical cure of hernia. If this is not feasible, or the patient declines an operation, a well-fitting, well-moulded truss and pad should be worn to prevent the protrusion from increasing. A vagino-cystocele should be treated by an operation for tightening and shortening the anterior vaginal wall.

Ectopion vesicæ or exstrophy of the bladder.—Ectopion vesicæ is characterised by a failure in development of the anterior wall of the bladder and of the abdominal wall in front of the bladder; whilst the posterior wall of the bladder projects at the hypogastrium, where it is continuous with the anterior abdominal parietes.

Ætiology.—This malformation is more frequent in boys than in girls in the proportion of eight or nine to one.

Its cause is still unknown, but the theory generally accepted is that it is due to an arrest in development of the anterior portion of the allantois as well as of the ventral lamellæ which form the abdominal walls.

Pathological anatomy.—Ectopion vesicæ appears as a florid

As a result of the constant trickling of urine, these patients are always wet and in discomfort, and frequently affected with erythema, excoriations, erysipelas, or more deeply-seated inflammation of the skin and tissues around.

As a rule, sexual appetite is wanting, but in the female a few cases of conception have been recorded, with offspring naturally delivered.

Malformations of other organs and parts are frequently found with ectopion, especially those connected with the anus. Double inguinal hernia is very common. Ectopion is not incompatible with a long life.

Treatment.—Many appliances have been invented to collect the urine and to prevent the irritation of the sensitive mucous membrane of the bladder. They are not very successful in their object. The best are those designed by Earle, of London; Jurine, of Geneva; and Bonn, of Amsterdam. They consist essentially of a sort of cup, applied over the exstrophy, communicating by a tube with a reservoir fastened to the thigh, and may be provided with a valve at the top and a tube and tap below.

Many and ingenious operations have been devised to remedy this deformity. The results of these operations are only palliative, and only partially successful even to that extent. The reason of this is the absence of the vesical sphincter, which renders the patients unable to retain their urine after even the most successful operation. The dangers that attend the operations are purulent infection of the urinary mucous tract, hæmorrhage, erysipelas, and sloughing of the flaps. It must suffice here to mention the various plans that have been tried.

(1) The method most in vogue is what is known as the *auto-plastic* method, i.e. closure of the extroversion by means of cutaneous flaps, the epithelial surface of each flap lying next to the mucous membrane of the bladder. By this operation the escape of urine is limited to a single spot, where it can be controlled by a well-fitting urinal. Moreover, by this method the sensitive mucous membrane of the bladder is protected from the constant friction of the clothes. Some patients when they have reached puberty have suffered much irritation and distress from the growth of hair on the bladder side of the inverted flaps.

(2) Establishing a fistulous communication between the ureters and the rectum.

(3) Making a fistula between the bladder and the rectum. The mortality of these last two methods is 40 per cent. It has been found that the rectal mucous membrane, after a time, becomes fairly tolerant, and patients have been able to retain urine within the sphincter ani for a certain length of time. This method may be combined with

(4) Closing of the bladder by suturing its margins and approximating the symphysis pubis, which is represented in these cases by a band of fibrous tissue. Dubuis, Dupuytren, and, more recently, Trendelenburg and Passavant have sought to obtain a radical cure

If proper treatment is not adopted, any form of the affection may become very troublesome.

Treatment.—In simple nocturnal incontinence, with no symptoms during the day, moral treatment is the most useful. The little patient must not be scolded, or punished, or reproached, or made a laughing-stock of. He should be encouraged, reassured, and even told not to mind the accident. Much is gained if a few nights pass without an accident, and this is sometimes obtained by waking the child just before the hour at which the nurse has ascertained micturition takes place. Means are sometimes recommended to lighten sleep and increase the irritability of the neck of the bladder. A hard bed, a little tea or coffee taken late before going to bed, are calculated to obtain the one aim, and the passage of catheters or sounds will sometimes accomplish the other.

For incontinence due to irritable bladder, the treatment consists of the removal of the cause; thus circumcision, division of the meatus, vermifuge remedies, improvement in dietary to correct oxyuria or lithiasis, are the means that should be employed.

Incontinence from defective contractile power of the vesical sphincter will often be rapidly cured by electrolysis applied to the hypogastrium, or even within the cavity of the bladder.

INJURIES OF THE BLADDER.

Wounds of the bladder.—Wounds of the bladder may be punctured, incised, or contused, gunshot injuries being included in the latter class. The bladder is most easily wounded from without when it is distended, for when contracted it sinks into the pelvis and is protected to a certain extent by the symphysis and rami of the pubes. Wounds of the bladder may be inflicted from without by stabs, bullets, in operations for adherent ovarian cysts, etc., or from within by surgical instruments or foreign bodies. They may be penetrating or non-penetrating.

Non-penetrating wounds may concern either the outer or inner surface. They most frequently occur in the course of surgical operations, as when adhesions of the bladder have to be separated in the course of operations on the abdomen and pelvis.

Non-penetrating wounds of the inner surface of the bladder are made necessarily during the removal of vesical growths; accidentally, by the clumsy use of the lithotrite, by the frequent impact of a catheter on the same spot of mucous membrane, by foreign bodies, and by the rough sharp edges of calculi.

Penetrating wounds are either intra- or extra-peritoneal, or both—i.e. when the wound involves the bladder wall at the line of reflection of the peritoneum. In these cases the urine escapes and the bladder contracts immediately it is wounded, unless, as in the corresponding condition of the intestine, the wound is very small, and is plugged by the bulging mucous membrane, and then there will be little, if any, extravasation.

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Hæmorrhage in these cases must be managed on the general principles applicable to all cases. In every event, the most scrupulous care should be used to keep the wound aseptic; and this is best

done after the insertion of a drain tube, by packing the wound with iodoform or carbolised gauze, and having an ample quantity absorbent iodoform cotton-wool, frequently changed, in contact with the perinæum and buttocks.

Rupture of the bladder.—Rupture of the bladder is very rare, very likely to be overlooked, or to be mistaken for peritonitis or some other lesion, and is very fatal. Indeed, to be treated properly and with any hope of success, it must be seen early and diagnosed promptly.

The rupture may be intra-peritoneal, i.e. involve the serous covering of the bladder, or extra-peritoneal, in which case the rupture takes place into the cellular tissue behind the peritoneum. An extra-peritoneal rupture may secondarily involve the peritoneum, and become intra-peritoneal.

Ætiology.—Ruptures of the bladder are of three kinds: traumatic, pathological and idiopathic.

The *traumatic* are caused either by violence from without or by violent muscular efforts on the part of the patient himself. The *pathological* result from ulceration, sloughing, thinning, and sacculation of the parietes. The *idiopathic* occur from the spontaneous yielding of the distended bladder, independently of any form of violence, or of previous ulceration or sloughing, or of tunicary hernia.

Traumatic rupture.—There are certain predisposing circumstances that favour rupture of the bladder when violence is applied to it. Distension at the time of traumatism, though not necessary, strongly predisposes to rupture by bringing the bladder into contact with the abdominal walls, and by stretching and thinning the viscus. Intoxication, by deadening the sensation of distension and rendering the abdominal muscles more flaccid and less excitable under reflex irritation, is a powerful predisposing cause. Old adhesions abnormally fixing the bladder to surrounding parts facilitate rupture in certain cases.

The traumatism that ruptures the bladder may be applied *directly* to the bladder by crushes of the abdomen by cart-wheels, etc., or by fracture of the pelvis, or by violent muscular contractions, such as when lifting heavy weights when the bladder is distended, or during the pains of labour, or straining at stool with distended bladder and stricture. Or traumatism may be applied *indirectly* to the bladder, as in cases of rupture from falls on the feet, tuberosities of the ischia or back.

Traumatic ruptures form the bulk of all cases.

Pathological rupture.—This is caused by the bladder weakened at certain spots by ulceration or tunicary hernia, giving way under distension (Fig. 903), or by the bladder sloughing as the result of pressure or inflammation. The most common causes are the pressure of a retroverted gravid uterus, or of an extra-uterine gestation. A case of pathological rupture due to the yielding of a simple ulcer three inches in diameter has recently been recorded by Dr. Johnson of Bolton.

athic rupture.—Under this heading comes a very small **ases** in which rupture has occurred from simple over-**without** any disease being present or any violence being **every** case is preventible by catheterism, or aspiration of **r**, they are generally a cause of reproach to the medical

The possibility of rupture in this way ought always to **ered**.

logical anatomy.—The character of the rent will vary **use** of the rupture. The posterior surface of the bladder is **n** site for rupture, and the rent is usually either vertical

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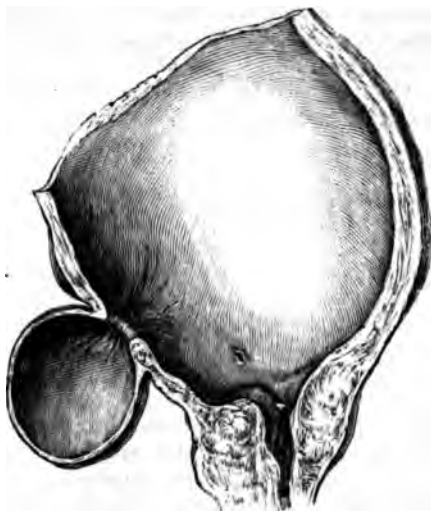


Fig. 903.—Diverticulum of the Urinary Bladder. (After Orth.)

must be remembered that the effusion of a small quantity **urine** is harmless to the peritoneum, especially if it can **it**, and moreover, urine may be rapidly absorbed. Thus **scurs** within three days, a large quantity may be present **ere** being any signs of peritonitis. If, on the other hand, **i** is persistent and septic elements are introduced, and the **mposes**, an acute peritonitis is rapidly set up.

oms.—If the individual, before the rupture took place, **uffering** the discomfort or pain of retention, he will, as **first** symptoms of pain and collapse occasioned by the **ve** passed off, experience a feeling of relief. This will be **f** duration, for soon he will be distressed by hypogastric, **r** general abdominal pain; and by frequent and urgent **iss** water. On attempting to micturate, nothing, or only **of** blood, or a little urine mixed with blood, will come

dislocations, add enormously to the dangers, and these cases, complicated as they so frequently are by other severe injuries, are generally quickly fatal. Speedy and correct diagnosis, and correspondingly prompt treatment, are the two necessary conditions for saving life where injuries to other parts are not of themselves necessarily fatal.

Treatment.—The first thing in many cases will be to attend to the condition of extreme shock by the application of warmth, gentle stimulation, etc., requisite in all such cases. Next must be the prompt local treatment for limiting further escape of urine, by providing a ready exit by catheter or perineal incision, and by closing the wound in the bladder by sutures, when the rupture is intraperitoneal. This subject has already been fully treated of in the section on penetrating wounds of the bladder (page 925), and no further description is needed here.

INFLAMMATION OF THE BLADDER.

Inflammation of the bladder, or cystitis. Acute cystitis.

Causes.—As in inflammation of other organs and tissues, the invasion of the bladder by pyogenic organisms is the determining cause of acute cystitis. Such organisms may be introduced into the bladder by catheterisation, either owing to the catheter itself being dirty, or, in cases where a catheter is retained, by an open channel for infection being left between the bladder and external air through the lumen or by the side of the catheter; or again, by the catheter carrying with it, on its introduction into the bladder, infective organisms from the prepuce, or glans penis, or urethra. The specific virus of gonorrhœa or urethritis may find its way directly into the bladder from the urethra, or pyogenic bacteria may be introduced from without, through the medium of wounds of the bladder, surgical or otherwise. Possibly also the virus of certain of the continued fevers and general infective diseases may be capable of setting up an acute cystitis.

Besides these determining causes, there is also present in many cases a local or general predisposing cause, which renders the bladder a suitable nidus for the propagation and growth of pyogenic organisms. Everything that is provocative of congestion of the bladder predisposes to cystitis. Thus obstruction to the outflow of urine in stricture and enlarged prostate leads to stagnation of urine in the bladder, and so induces congestion. So, too, the bladder may be irritated by the presence of a catheter, foreign body, tumour, or calculus. Interference with its nervous supply, as in fracture and certain diseases of the spinal cord, or the state of the urine, such as extreme acidity in gouty subjects, or the presence in it of certain drugs, such as cantharides or turpentine, may one and all provoke congestion of the bladder, which is readily converted into an acute cystitis by the introduction of the pyogenic microbe.

Pathological anatomy.—Not much is known, as the affection is

happily not often fatal. The trigone is the chief seat of inflammation, and the mucous membrane is commonly alone affected. The first change is injection and swelling of the mucous membrane, which becomes of a bright crimson colour in contrast to its normal rose tint. Occasionally the mucous membrane breaks down in places, leaving small ulcers. The muscular coat may subsequently become involved in the inflammatory process.

Symptoms.—The onset is sudden in some cases : more insidious in others. There is severe pain on micturition radiating along the urethra, and frequent desire to micturate. The pain may be agonising, and is worse at the beginning and end of micturition, but ceases after micturition is completed. The frequency varies, but micturition follows uncontrollably on the impulse, and there is much tenesmus. The urine is neutral or alkaline, and contains pus, which is equally diffused through the urine. In the very acute cases blood is present as well as pus, and the urine then has, as Mr. Reginald Harrison describes it, the appearance of thin prune-juice. Small clots of blood are often mixed with the sediment. Fever is absent in uncomplicated cases. When fever is present it is certain that inflammation has extended to the prostate, perivesical tissue, or upwards to the ureters and kidney. The bladder is tender to the touch as experienced by examination per rectum or per vaginam.

Diagnosis.—The affection, as a rule, is easily diagnosed by three classical symptoms—frequency of micturition, painful micturition, and pyuria. The presence of all three of them is necessary. Either taken alone goes no way towards establishing a right diagnosis. Thus pain and frequency of micturition will occur in congestion of the bladder from any cause above-mentioned ; but if the pyuria, the sure sign of the presence of pyogenic microbes, is not present, the case cannot be regarded as one of acute cystitis.

In pyelitis and suppurative pyelo-nephritis there is pyuria and sometimes frequency and slight pain on micturition ; but the fever and constitutional symptoms are much more severe ; the pain on micturition is not agonising, whilst the reaction of the urine is acid, and not alkaline as it is in cystitis. As above stated, a primary acute cystitis may extend up the ureters and infect the kidney, and then the symptoms of the bladder and kidney affection will be merged.

Prognosis.—Cystitis from urethritis is readily cured, often in a week, by the proper treatment ; if neglected, it will pass into chronic cystitis. When caused by calculus, stricture, new growths, or foreign bodies, the removal of the cause is often followed by a very rapid, almost magical cure. Cystitis is often very difficult to relieve when due to enlarged prostate.

The prognosis becomes serious when the affection arises in old men whose vitality is decreased or prematurely lowered by the presence of a hypertrophied prostate, or when renal complications ensue, or if the case is neglected. Thus the cause of the affection and the length of time it has existed are powerful factors in the prognosis.

Treatment.—The cause of the disease must be removed as soon as possible. In many cases cystitis is the indication for an immediate operation, as for instance when it is excited by the presence in the bladder of a foreign body, calculus, growth, or by urethral stricture.

Preventive measures ought always to be taken against exciting cystitis by catheterism, or by forced injections, in cases of gonorrhœa, or deep urethral discharges.

For the rest, the treatment consists in palliating pain by hot baths, hot fomentations to the hypogastrium and perinæum; by morphia suppositories of half to one grain in very acute cases, or by subcutaneous injections of morphia; all articles of diet likely to make the urine irritating, such as highly-spiced food, coffee, alcohol in all its forms, etc., must be avoided. Irrigation of the bladder, so good in chronic cystitis, must, as a rule, be shunned in the acute; although benefit follows in some cases from the injection of a few drops of a solution of nitrate of silver, gr. j to \bar{z} iv, increasing to gr. j to \bar{z} j, as recommended by Sir Henry Thompson.

In long-continued cases, cystotomy may be required to relieve the tenesmus and give rest to the bladder by drainage.

Chronic cystitis.—The determining and predisposing causes of chronic cystitis are the same as those enumerated under acute cystitis. Any form of acute cystitis may terminate in the chronic form, or the inflammation may be from the very first of a chronic or indolent kind; and this is especially often the case in old men, in whom cystitis is set up by the obstruction of an enlarged prostate.

Pathological anatomy.—The mucous membrane of the bladder is of a slate colour, ecchymosed in places, and marbled, purple, black, or green, and covered with an adherent layer of muco-pus. Sometimes there are large or small ulcers on the surface. The changes in the mucous membrane affect the bladder throughout, but are most marked about the trigone, and are least so about the base of the bladder. The mucous membrane is softened, thickened, and swollen, and sometimes small abscesses are present both in the membrane and beneath it. Such abscesses are rarely larger than a pea, and tend to open into the cavity of the bladder. In a few cases a desquamative process occurs in the mucous membrane, and portions are shed per urethram, and in very rare cases a complete mucous cast of the interior of the bladder has been passed. This variety has received the name of croupous cystitis. There is, rarely, actual sloughing of the mucous membrane, and the term gangrenous cystitis is applied to such a case.

Symptoms.—Chronic cystitis may come on slowly and insidiously, as is often the case in old prostatic cases in which the catheter is daily or frequently used; or it may succeed to acute cystitis. Conversely, intercurrent attacks of acute cystitis occur in the course of a prolonged chronic inflammation. The symptoms are the same as those of acute cystitis, but in a very much milder degree. The three cardinal symptoms—frequency of micturition, painful micturition,

and pyuria—are present together. The degree of pyuria is extremely variable. It is always most abundant at the commencement and finish of micturition, indicating its chief source to be the mucous membrane in the neighbourhood of the neck of the bladder. It differs, too, much in appearance in different cases, being sometimes yellowish or greenish, in others having a tenacious, glairy, stringy character, adherent to the bottom of the vessel, like a gelatinous coating of greater or less thickness, which, on pouring off the urine, cleaves for some seconds to the vessel, and then falls from it like a solid or semi-solid mass. It is the abundance of this last-named secretion with but slightly increased frequency of micturition, and little or no pain, which caused the name “catarrh of the bladder” to be given to such cases of chronic cystitis. In stricture cases retention of urine is often caused by the blocking of the narrowed portion of the urethra with this tenacious, gluey secretion. Even if it does not cause retention, it gives rise to great pain and difficulty from the efforts required to make it pass through the urethra.

The urine of chronic cystitis is alkaline, and has a strong offensive odour even when it is not actually ammoniacal. When the mucous membrane is sloughing, the urine has an odour characteristically offensive.

The physical symptoms of chronic cystitis are very slight, and the general good health is maintained by many patients for a long time, even when the quantity of muco-pus is very large. After a time, however, the patients become feeble, lose flesh, look pale and sallow, get a dry skin and furred tongue, and their digestion becomes difficult or painful. In a large number of cases chronic pyelo-nephritis is gradually induced; in others, an acute attack of suppuration throughout the higher urinary mucous tract carries off the patients.

Diagnosis.—This is usually straightforward. As in acute cystitis, there are the three cardinal symptoms—frequency of, and pain on, micturition, and pyuria. Tuberculosis of the bladder and pyelo-nephritis are the two conditions most likely to be confused with it. Between chronic cystitis and tuberculosis the diagnosis is often obscure; but the absence of any obvious cause for cystitis, the insidious onset, the history, presence of tubercle elsewhere, and probable presence of the tubercle bacillus in the urine, will all help to clear up the case. In pyelo-nephritis the constitutional symptoms are much more severe, the urine is acid, and there is often slight frequency and pain on micturition. If the bladder be carefully washed out, the urine flowing from the catheter immediately afterwards contains pus.

Prognosis.—Chronic cystitis threatens life through its liability to lead on to pyelo-nephritis. If the local cause can be removed, as in calculus and stricture, the prospect is much more favourable than in chronic prostatic disease or other conditions that act permanently. Pain and increased frequency are much more serious than the pyuria, because the broken rest which they cause soon wears out the

patient; whereas with free suppuration, attended by little or no pain or frequency of micturition, rest is unbroken, and the health is maintained for a long time.

Treatment.—This is prophylactic, as well as remedial. Prophylactic treatment consists in the strictest asepsis as regards instrumentation of the bladder, and in removing as soon as possible any local cause for cystitis, such as calculus, foreign body, stricture, etc.

The remedial treatment is local and constitutional. The local treatment consists in the daily irrigation of the bladder by suitable antiseptic solutions. This irrigation must be conducted on a careful and systematic plan, not only as regards the details of aseptic precautions, but in other respects as well. It is harmful to throw in much fluid at a time, or to inject it with much force. A tender inflamed bladder would be irritated, not improved, by such treatment. Where possible, a soft flexible catheter of No. 8 or 9 size should always be used; the solution to be injected should be of the temperature of the body, and should not be too strongly impregnated with the antiseptic substance. Only from two to three or four ounces at a time should be injected, and then, after being retained for a few seconds in the bladder by keeping the fingertip on the end of the catheter, it should be allowed to escape. This process should be repeated till the solution returns as clear, or nearly so, as when it was injected.

Various solutions are employed, thus: acetate of lead, one or two grains to four ounces of water; dilute nitric acid, two or three minims to the ounce; dilute phosphoric acid, three or four minims to the ounce; acetic acid, four minims to the ounce. These are especially useful where there is a great tendency to phosphatic encrustation of the bladder. By irrigating the bladder micro-organisms are eliminated, the products of inflammation are removed, and the bladder is cleansed from stringy mucus and decomposing urine.

In some cases of enlarged prostate intra-vesical irrigations cause much pain. In these cases the bladder may be medicated by disinfecting suppositories introduced per urethram by a special instrument, or what are known as "vesical instillations" may be employed. These consist of a few drops of some strong medicinal remedy, such as nitrate of silver, which is introduced through a catheter, the bladder being empty at the time.

The constitutional treatment consists in dieting, a simple and non-stimulating regimen being enforced, and in the internal administration of drugs, which may act soothingly on the mucous membrane of the bladder, such as hyoseyamus, buchu, and alkalies; and lastly, in the relief of pain by opium or morphia, if necessary.

Where pain and other symptoms continue severe and unarrested, after the trial of the various means above described, the bladder should be put into a state of rest for a fortnight or three weeks by draining it through the perinaeum or above the pubes; this treatment has often been attended with success, the patient afterwards making a speedy and uncomplicated recovery.

Tuberculous disease of the bladder.—Tuberculous disease of the bladder is much more common in men than in women, in the proportion of three to one. It may occur primarily in the bladder, but much more commonly the bladder is affected secondarily from the lungs, etc., or by extension of the disease from the kidneys, testes, or prostate.

Ætiology.—The exciting cause is the invasion of the bladder walls by the tubercle bacillus, but there are a few predisposing causes, both general and local. The general are the same as predispose to tuberculous disease in other organs, whilst the local consist in the damaging of the vesical tissues by chronic inflammation due

to other causes than tubercle, such as gonorrhoea, etc. In such case the bladder is less capable of resisting the invasion of the tubercle bacillus.

Morbid anatomy.

—The bladder is generally small, shrunken, and thickened, and surrounded by a bed of sclerosed fibro-fatty tissues. The mucous membrane is red, irregular, and fungous-looking, especially about the trigone and about the orifices of the ureters (Fig. 904); minute grey miliary tubercles are occasionally seen, more or less confluent, but not



Fig. 904.—Tuberculous Disease of the Bladder and left Ureter. (After Orth.)

forming the larger cheesy masses so often met with in the kidneys, prostate, testes, and vesiculæ. Ulceration is present in the more advanced stages. Such ulcers have the typical appearance of tuberculous ulcers elsewhere. They may, though rarely, cause perforation of the bladder walls, and fistulous openings into the rectum, vagina, or perineum. If the disease occurs primarily in the bladder, it may spread upwards to the ureters and kidneys, or downwards to the prostate and urethra. It is very rare for the bladder to be the only part of the genito-urinary tract affected at death.

Symptoms.—The first symptom is frequency of micturition after meals and at night. Then the urine is slightly tinted more or less, and at longer or shorter intervals, with blood. Later still, pain occurs and the urine is much thicker and contains pus. The frequency of micturition comes on gradually and increases, so that in the later stages the patient may have to pass water every

hour or half-hour. The frequency is generally increased at night. *Hæmaturia* is often an early symptom, but is usually only slight in amount, and not constant in its presence. In the early stages it is due to congestion of the vesical mucous membrane; later, it may arise from ulceration into a small vesical vessel, and may then be considerable. The extent of pain varies. In some cases it is slight and intermittent, in others intense and continuous, especially preceding, accompanying, and following micturition. It does not appear until the tuberculous process has set up cystitis. The quantity of urine is increased in the early stages of tuberculous disease of the bladder. When cystitis occurs, it contains pus, the amount of which varies. The pus is chiefly contained in the urine first discharged. Tubercle bacilli may be found in the urine before cystitis sets in, but are rarely found after the urine has become purulent. After cystitis commences, the bacilli of common suppuration are present. Constitutional symptoms are not prominent, and the disease may exist for a long period without much disturbance of the general health.

Diagnosis.—Vesical tuberculosis ought to be suspected in any case in which frequency of micturition, with slight hæmaturia, occurs in a person between the ages of fifteen and forty-five, especially if the individual has a tuberculous aspect or family history, and no obvious cause for such symptoms, such as stricture or calculus, exists. If to these symptoms an attack of cystitis is added, or if, on examination of the prostate, vesiculæ, spermatic cord, or epididymis, a hard nodule is found in any of them, or if the lungs afford corroborative evidence of tubercle, the diagnosis becomes fairly certain.

From tuberculosis of the kidneys and ureters the diagnosis is often very difficult. There may be a lumbar tumour with pain and tenderness in the loin. The amount of pus passed from an affected kidney is usually much greater than that from the bladder, whilst it is more equally diffused throughout the urine. The latter, too, will remain acid, unless the bladder becomes secondarily affected. Constitutional disturbance is much greater in renal disease. Of course it must be remembered that both renal and vesical tuberculosis may co-exist, and then the symptoms of one are merged in those of the other.

Vesical calculus is sometimes simulated by the pain and hæmaturia. In calculus both are relieved by rest and posture, which is not the case in tuberculosis. The sound will clear up the case where there is any doubt.

Prognosis.—It must be remembered that the course of tuberculosis of the bladder is a slow one, and though it is complicated with acute attacks there are also frequent periods of amelioration so considerable that a cure seems likely to occur. Thus the disease may last, not months only, but even several years.

The progress is generally more rapid in cases in which the tuberculosis of the bladder is secondary to pulmonary tuberculosis. When the testicles and vesiculæ seminales are involved in a case in

which the bladder symptoms are recent, the prognosis is more unfavourable. So, too, is it when severe and obstinate cystitis sets in, for then the strength of the patient rapidly gives way to the pain, discharge of pus, and loss of sleep and rest.

It is very rare for hæmorrhage to be severe enough to threaten life, even when due to ulceration of the bladder. The end is generally brought about by pyelc-nephritis of the common suppurative form, if the tuberculous process itself has not reached the kidneys. Occasionally, tuberculous peritonitis, acute phthisis pulmonalis, or acute general tuberculosis is the immediate cause of death.

Treatment.—All forms of local treatment of the bladder are contra-indicated in tuberculous disease, except in the later stages, where there is constant intense pain and much irritability of the bladder with cystitis. In such cases drainage of the bladder, either above the pubes or through a perineal incision, has afforded much relief. Injections of various solutions such as nitrate of silver, iodoform, or mercury have all been frequently tried in the cystitis of tubercle, but have met with but scant success. Before cystitis has set in, the bladder should be left strictly alone. Irrigation of the bladder at any period of the disease is worse than useless; it is often actively harmful before suppuration has commenced. Irrigation is contra-indicated in all cases of ulceration or where there is a tendency to bleed, and in tuberculosis of the bladder ulceration and hæmorrhage are both frequent.

Thus it is to medicinal rather than to surgical means that the patient should look for benefit. Due attention should be paid to clothing. Residence in a warm, dry climate, and sea voyages, combined with tonics such as cod-liver oil and arsenic, should be prescribed. The diet is of much importance, and all articles of food which, through the urine, irritate the bladder, should be avoided, such as all forms of stimulants and highly-flavoured dishes, curries, spices, etc.

STONE IN THE BLADDER.

Ætiology.—Vesical calculus may originate in the bladder; or may be primarily formed in the kidney, and when still of small size be passed thence into the bladder, where it remains localised and may subsequently increase in size. The primary cause of the formation of calculus is a morbid condition of the urine and the precipitation of certain salts therefrom. Such a morbid state of the urine may be produced either by some constitutional or some local cause. There are, therefore, two distinct classes of calculi: (1) those formed out of the constituents of the urine, owing to some constitutional state, or diathesis; and (2) those of local origin, derived from the precipitation of the phosphates, and whether primarily originating in the bladder or elsewhere, such as the renal pelvis or urethra, caused by a septic state of the urine. To the first class belong calculi composed entirely of uric acid or its salts, or

late of lime or cystine, or of an admixture of two or more of these substances; whilst to the latter class belong calculi composed of ammonio-magnesian phosphate or phosphate of lime. To both classes belong a very large percentage of calculi which exhibit both uratic salts, and those of uric or oxalic acid, or both, and in

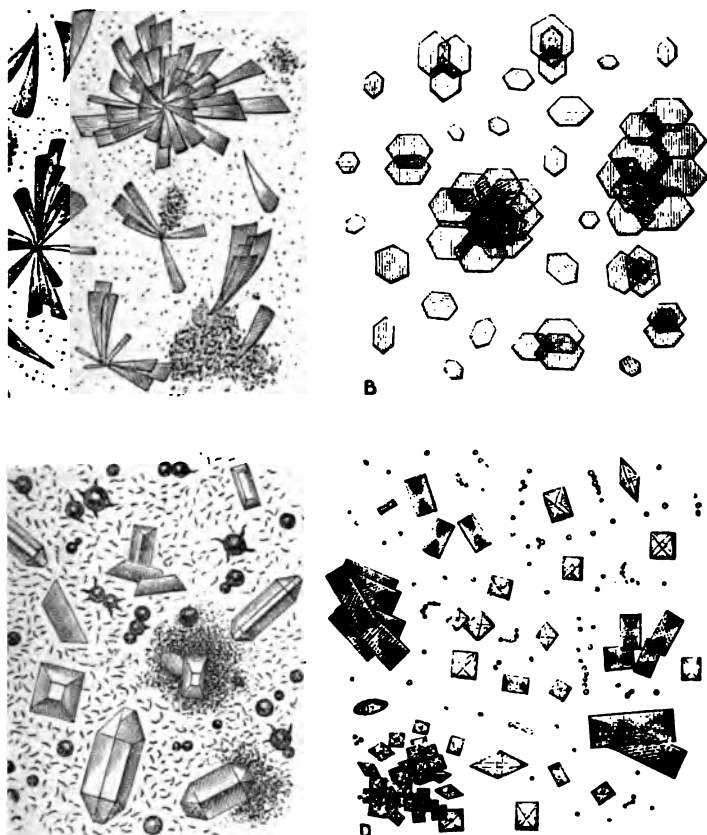


Fig. 905.—Crystals. (Modified from Ultzmann and Hoffmann.)

struvite (magnesium ammonio-phosphate) of lime; several are arranged together with their points towards a centre. The star-shaped plaques consist partly of carbonate and partly of amorphous tribasic phosphate of lime. B, Cystine, six-sided tablets, which in one place are gathered together in a large six-sided tablet. C, Sediment of urine undergoing alkaline fermentation. It consists of transparent sarcosine-shaped crystals of triple phosphate, of brown plain or pointed double balls of urate of ammonia, and of an amorphous mass of tribasic phosphate of lime mixed with bacteria. D, Sediment of urine undergoing acid fermentation. It consists of brown crystals of uric acid, of crystals of oxalate of lime, and chains of yeast cells.

h, therefore, both constitutional and local causes are at work in its formation.

1. **Constitutional predisposing causes.**—Owing to imperfect nutritive processes and to the gouty diathesis, there is a great tendency to the formation of uric acid and the urates in excess in the

e e *

blood, and these substances are then excreted in such quantity by the kidneys as to be deposited either in brickdust-red or cayenne-pepper-like particles which we call uric acid gravel; or as a powder of light yellow, fawn, or pink colour, which are the salts formed by uric acid in combination with soda or ammonia. It is the same with cystine and some forms of oxalate of lime gravel (Fig. 905).

Calculi are also ascribed to other causes, such as cold climates, too highly nitrogenised food, articles of drink or diet too rich in oxalic acid, insufficient exercise, hereditary predisposition apart from inherited gouty tendencies, and the imbibition with drinking water of the distoma hæmatobium (bilharzia hæmatobia). Vesical calculus occurs much less frequently in women than in men, because, owing to the shortness and dilatibility of the female urethra, calculi that can traverse the ureters can easily escape from the bladder. Moreover, gout is rarer in women than in men.

Calculus occurs in the vast majority of cases at the two extremes of life. The greatest number of cases are seen in men from fifty-five to seventy-five, and in children below the age of puberty. This is partly due, no doubt, to obstruction to the escape of a small stone from the bladder; to prostatic hypertrophy in the former case, and to the small size and rudimentary condition of the urinary organs in the latter. It is worth noticing that whereas stone is common amongst the children of the poor, as compared with those of the richer classes, it is a rare disease amongst men of the labouring class as compared with the number of cases occurring in men of the well-to-do stations of life.

2. Local predisposing causes.—Any condition that tends to the stagnation of urine in the bladder and to the development of cystitis acts as a local predisposing cause of vesical calculus.

When these two conditions, decomposition of urine and cystitis, occur, as they so often do, together, the ammonio-magnesian phosphates are precipitated. This precipitation may occur spontaneously, and thus lead to the formation of a primary vesical calculus; or it may take place even more readily around a concretion which has descended from the kidney, and this is the process by which uric acid calculi become enveloped in a white casing of the phosphates.

It is by this same precipitation of the phosphates that foreign bodies in the bladder become encrusted with salts, and that thus are formed calculi with such things as blood-clots, pieces of bone, hairpins, twigs of trees, berries, and a host of others, for their nuclei. In the same way, too, the surface of vesical tumours and the ends of catheters retained in the bladder become encrusted with a white layer, more or less thick, of the mixed phosphates. Aseptic bodies will remain long in the bladder without causing the precipitation of the salts of the urine, but not so septic foreign bodies.

Physical and chemical characters of stones. **Numbers.**—In children there is generally one calculus; in adults there are often several in the same bladder; in rare instances from 50 to 300 and more have been noted; but it is very common to remove two, three,



Treatment.—The cause of the disease must be removed as soon as possible. In many cases cystitis is the indication for an immediate operation, as for instance when it is excited by the presence in the bladder of a foreign body, calculus, growth, or by urethral stricture.

Preventive measures ought always to be taken against exciting cystitis by catheterism, or by forced injections, in cases of gonorrhœa, or deep urethral discharges.

For the rest, the treatment consists in palliating pain by hot baths, hot fomentations to the hypogastrium and perinæum; by morphia suppositories of half to one grain in very acute cases, or by subcutaneous injections of morphia; all articles of diet likely to make the urine irritating, such as highly-spiced food, coffee, alcohol in all its forms, etc., must be avoided. Irrigation of the bladder, so good in chronic cystitis, must, as a rule, be shunned in the acute; although benefit follows in some cases from the injection of a few drops of a solution of nitrate of silver, gr. j to ʒiv , increasing to gr. j to ʒj , as recommended by Sir Henry Thompson.

In long-continued cases, cystotomy may be required to relieve the tenesmus and give rest to the bladder by drainage.

Chronic cystitis.—The determining and predisposing causes of chronic cystitis are the same as those enumerated under acute cystitis. Any form of acute cystitis may terminate in the chronic form, or the inflammation may be from the very first of a chronic or indolent kind; and this is especially often the case in old men, in whom cystitis is set up by the obstruction of an enlarged prostate.

Pathological anatomy.—The mucous membrane of the bladder is of a slate colour, ecchymosed in places, and marbled, purple, black, or green, and covered with an adherent layer of muco-pus. Sometimes there are large or small ulcers on the surface. The changes in the mucous membrane affect the bladder throughout, but are most marked about the trigone, and are least so about the base of the bladder. The mucous membrane is softened, thickened, and swollen, and sometimes small abscesses are present both in the membrane and beneath it. Such abscesses are rarely larger than a pea, and tend to open into the cavity of the bladder. In a few cases a desquamative process occurs in the mucous membrane, and portions are shed per urethram, and in very rare cases a complete mucous cast of the interior of the bladder has been passed. This variety has received the name of croupous cystitis. There is, rarely, actual sloughing of the mucous membrane, and the term gangrenous cystitis is applied to such a case.

Symptoms.—Chronic cystitis may come on slowly and insidiously, as is often the case in old prostatic cases in which the catheter is daily or frequently used; or it may succeed to acute cystitis. Conversely, intercurrent attacks of acute cystitis occur in the course of a prolonged chronic inflammation. The symptoms are the same as those of acute cystitis, but in a very much milder degree. The three cardinal symptoms—frequency of micturition, painful micturition,

from incessant contractions set up by the presence of a stone which irritates it as does a foreign body. Cystitis is an occasional complication.

Although in a few instances stone in the bladder has given rise to no symptoms whereby its presence might be detected, yet in the vast majority of cases indications of its presence are numerous and conspicuous. The three cardinal symptoms of stone are: (1) pain; (2) frequency of micturition; and (3) hæmorrhage. Each of these has special characteristics indicative of stone. To these must be added several other subsidiary symptoms, which will be mentioned later.

Pain.—This may be sharp or dull in character. It is much increased by any exercise, especially that of a jolting or shaking character, such as riding or driving. It disappears when the patient is recumbent. It is also caused by the contractions of the bladder, and especially at the end of micturition, when the bladder is contracted on the calculus. There is often an itching, sometimes severe pain, at the end of the penis which leads the patient to pull upon and squeeze the organ; and in children who cannot express their feelings this is an important sign.

Frequency of micturition, like pain, is increased by movement. During rest and at night it is much diminished or normal.

Hæmorrhage.—Like the two preceding symptoms, this is chiefly noticed after movement or active exercise. It may be absent for days if the patient remains in bed, only to recur as soon as he gets up or walks about. The blood may appear equally charged with the urine, or as a few drops of blood, or bloody urine, at the end of micturition. If this only occurs when micturition is performed standing, and not when lying down, it is very significant of stone.

Sudden stoppage of the stream of urine during micturition.—This may be due to the washing of a calculus against the urethro-vesical orifice. If the sudden stoppage occurs during micturition in the upright position, but never does so when the water is passed in the recumbent position, it is a very characteristic symptom. It is, however, a by no means constant symptom, and in some cases may be merely due to spasm and not to stone. In such a case the position of the patient during the act of micturition will not affect the presence of spasm.

Characters of the urine.—The urine may show no change beyond that of blood. In some cases crystals of uric acid salts, or of oxalate of lime, or triple phosphates, may be found under the microscope, or there may be a cayenne-pepper sediment of uric acid gravel. Later, if pyogenic organisms are introduced into the bladder by catheterism, etc., pus will be found. Calculus of itself, being an aseptic foreign body, cannot produce true cystitis. If cystitis has been present for any length of time the urine, besides containing pus, will be ammoniacal and alkaline.

Physical examination.—In boys a stone in the bladder can often be felt by digital examination per rectum. In adults this is

not the case, unless the stone be of considerable size, because the prostate and the depth of the perinæum prevent the finger from reaching high enough. In women a stone can often be felt per vaginam.

Sounding.—Although all the cardinal symptoms may be well marked, there is only one sure proof of the presence of calculus, and that is afforded by a metal catheter or sound, and an examination of the bladder in this way should always be made before venturing upon a positive diagnosis. The strictest asepsis should be observed in the performance of this little operation. The bladder, if the urine be not quite clear, should be washed out before introducing the sound, and a few ounces of irrigating fluid injected, or if the urine is normal, a few ounces of urine may be retained instead. The greatest gentleness should be employed. The presence of stone is indicated by little clicks or ringing sounds elicited by the contact of the metal with the stone. The bladder should be systematically explored in all directions. The buttocks of the patient should be raised on a pillow during the sounding. If the stone be phosphatic, it may be too soft to give any sound; but the little jarring of the sound when it comes in contact with it is readily detected by the experienced surgeon. By drawing the beak of the sound over the stone, its size, and the character of its surface, whether rough or smooth, can be approximately ascertained. If possible, sounding should not be performed when the bladder is in a state of acute inflammation.

Diagnosis.—Due attention to the symptoms above enumerated, together with the clinical history of gout, gravel, or an attack of renal colic due to a small calculus traversing the ureter, together with the exploration of the bladder by a sound, will clear up all doubt and difficulty in the vast majority of cases.

Calculus of the kidney can give rise to all the three cardinal symptoms of vesical calculus, and these symptoms are aggravated and ameliorated by precisely the same means in both classes of case. There is often no fulness, no tenderness in the region of the kidney in cases of renal calculus; and no more pain than is sometimes caused by cystitis or vesical calculus. The sounding of the bladder will alone settle the doubt. But let it be always borne in mind that many patients with vesical calculi live and die with stones in each of their kidneys. So that the discovery of a calculus in the bladder by no means proves that there is none in the kidney.

Causes of failure in sounding.—(1) The bladder wall and calculus may be covered with an abundant layer of glairy mucus. This forms one reason for well irrigating the bladder before sounding. The difficulty is most apt to rise with phosphatic calculi where the urine is neutral and contains much mucus. (2) The stone may be in a pouch behind an enlarged lobe of the prostate which projects into the bladder. (3) The stone may be in a sacculus of the bladder, and the orifice of the sacculus very small. (4) It may lie behind the pubes out of ready reach of the sound. (5) A small stone may be covered by a layer of swollen mucous membrane, a condition likely to occur if the bladder is congested or inflamed.

If stone cannot be detected after careful examination with sound, it may sometimes be discovered by injecting the bladder with a Bigelow evacuating bottle (Figs. 906, 907), and as the bottle expands, the fluid, rushing back into it, may wash the calculus against the end of the evacuating tube, producing a distinct click. The cystoscope may also sometimes detect an encysted stone after failure with the sound.

Where sounding, and the aspirating bottle and tubes, and the cystoscope have all failed, an inspection of the bladder through the hypogastric cystotomy opening is the last resource.

There are cases of calculi in diverticula of the bladder and in retro-prostatic pouches which cannot be localised or discovered in any other way.

Prognosis.—In a few recorded cases patients have lived for many years with calculus in the bladder, and have suffered little in health, but such cases are very rare. Usually, if the case is left to itself, progressive troubles arise that ultimately prove fatal.

It is the supervention of septic infection of the bladder, whether any operation has been done or not, that creates the dangers and conduces to the fatal result by exciting ascending suppurative pyelo-nephritis. It is the existence of this condition before the operation which adds so largely to the risks of surgical interference, and to which such small mortality as follows litholapaxy, as now practised by skilled hands, is attributable.

The spontaneous expulsion of calculi in the case of men cannot be reckoned upon; but women pass large stones through the urethra, and others still larger sometimes escape into the vagina by ulceration of the vesico-vaginal septum.

As a rare occurrence, spontaneous fragmentation of stones is known; it is due to molecular changes



Fig. 907.—Evacuating Tube and Stylet for Litholapaxy. (Weiss.)



Fig. 906.—Evacuator for Litholapaxy. (Weiss.)

that lead to their complete disintegration, and spontaneous expulsion of the fragments follows.

Treatment.—Litholapaxy as introduced by Bigelow and modified by Sir Henry Thompson and M. Guyon, is now the recognised operation for all cases (with few exceptions to be named presently) of vesical calculus in males. The operation consists in crushing the calculus with the lithotrite at one operation, whilst the fragments are removed by means of an evacuator (Figs. 906 and 907). This method has entirely replaced the operation of lithotrity, as practised by Civiale, in which the crushing of the calculus was extended over several sittings, each sitting being limited to a few minutes' duration. The fragments, in lithotrity, were left to be passed by the natural expulsive efforts of the bladder.

Lithotomy, however, cannot be banished from the category of useful and necessary surgical operations. It is the only operation possible for very large stones—beyond six centimetres if phosphatic, and five centimetres, if composed of uric acid or oxalate of lime,—for calculi so hard that they resist the strongest lithotrites, and for those very sensitive bladders which resent the slightest attempts to inject sufficient antiseptic solution to form a safe medium for the employment of the lithotrite. Some surgeons incline to the opinion that advanced renal disease is a reason for lithotomy rather than litholapaxy. The mortality incident to both operations is enormously increased by this cause, that of lithotomy being about 90 per cent. It is, however, the better practice to adopt litholapaxy.

Stricture of the urethra, which used to be considered a bar to lithotrity, is no longer so to the same extent or in the same way to litholapaxy; the stricture should be dilated or divided so that the urethra will readily admit the lithotrite and the evacuating tubes. If the stricture be divided, time should, when possible, be allowed for the healing of the wound in the urethra before operating upon the stone. Lithotomy, also, is the operation for encysted calculi, and cases where the stone is concealed behind a projecting lobe of the prostate.

As regards the choice between the various forms of lithotomy, the operation of election with most surgeons is the supra-pubic. The advantages claimed for it are—that (1) it allows of the complete inspection and evacuation of the bladder; (2) the operation and the wound subsequently can be kept completely aseptic; (3) it avoids the danger to the ejaculatory ducts, to the neck of the bladder, to the rectum, and to important blood-vessels that are in danger, yet cannot be seen, during the course of lateral lithotomy; (4) the opening made into the bladder can be free enough to allow of the extraction of very large stones without bruising or lacerating the tissues, which is not always the case in perineal operations; (5) the enlargement of the prostate is no obstacle in the operation, whilst it renders the perineal operation unsatisfactory or even impossible. The perineal operation combined with crushing the stone by means of strong forceps has been very successful in Harrison's hands.

There are, however, some few cases in which the best route to

the bladder is through a median incision in the membranous urethra. This is specially the case where some of the stones occupy a very dilated prostatic urethra, and where a prostatic calculus has extended through the urethro-vesical orifice into the bladder and there grown. It is the best operation in certain cases of stones of medium size where there is cystitis.

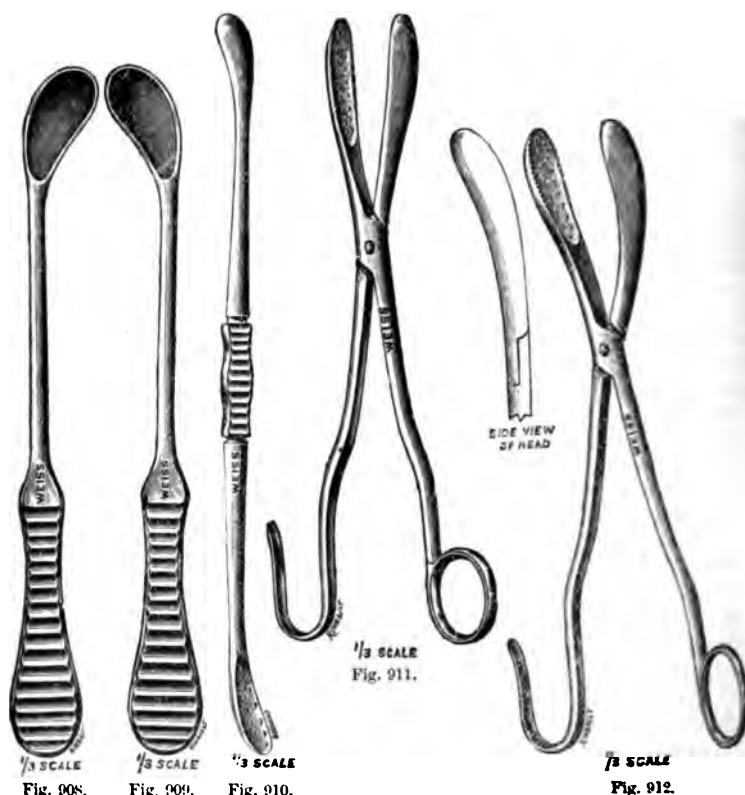


Fig. 908. Single Lithotomy Scoop—right.
(Weiss.)
Fig. 909. Single Lithotomy Scoop—left.
(Weiss.)

Fig. 910.—Double Lithotomy Scoop. (Weiss.)
Fig. 911.—Straight Lithotomy Forceps.
(Weiss.)
Fig. 912.—Curved Lithotomy Forceps. (Weiss.)

In *women*, lithotrity is rarely required because of the capacity and dilatability of the urethra; but it is the best operation when the stone is too large to be extracted entirely per urethram. In women with stone of a large size, vaginal cystotomy, followed by immediate sutures, is an easier, safer, and more satisfactory operation than the supra-pubic. In female children the best operation is litholapaxy.

In *boys*, lateral lithotomy has always been a most successful operation, and litholapaxy in rough or inexperienced hands is more

than usually dangerous in them. Indeed, cases are on record in which the bladder has been ruptured by the lithotrite. But in skilful hands, and with proper lithotrites, the results of litholapaxy are far better even than those of lateral lithotomy.

For the *technique* of the various operations employed for the relief of vesical calculus, the student is referred to works on operative surgery (Figs. 908 to 912).

FOREIGN BODIES AND TUMOURS IN THE BLADDER.

Foreign bodies.—Foreign bodies gain access to the cavity of the bladder :—

- (1) through the urethra,
- (2) by being forced through its walls by injury,
- (3) by means of ulceration, or the formation of a fistula.

1. Those which enter the bladder along the urethra include pieces of catheters, lithotrites, and filiform guides, which have been broken off either during some operation, or, in the case of catheters tied into the bladder, during their sojourn in that viscus.

Besides these, and forming by far the greater number, are the substances introduced by the patients, either to allay itching or tickling in the passage, or to dilate some real or imaginary stricture, or aimlessly, or for a sensual purpose. The variety of things that have been so introduced is almost endless, and comprises articles so different as the leaves or twigs of plants, eight or nine inches of indiarubber tubing, fruit berries, beads, bodkins, hairpins, a mouth-piece of a pipe, a pencil case, and a great number of other things.

2. Foreign bodies forced through the bladder walls include bullets, pieces of bone, clothing, buttons, etc.

3. Foreign bodies that ulcerate into the bladder or find their way along fistulous tracts come either from the ureters in cases where foreign bodies have first been lodged in the renal pelvis, or from vagina, rectum, or other portion of the intestine. Also fragments of a foetus in an extra-uterine foetation, hair and teeth from a dermoid cyst, or pus from a pelvic abscess or hydatid cyst may find their way into the bladder.

Pathological anatomy.—Foreign bodies, when in the bladder, may remain entirely quiescent, or may excite cystitis; after a time they may cause ulceration and perforation, and giving rise to a peri-vesical abscess, may escape by the direction through which the abscess is either opened or spontaneously discharged. Or the foreign body, having penetrated the vesical wall, may remain partly within the bladder, and partly within the peritoneal cavity.

Foreign bodies become encrusted with phosphates, and thus often become the nuclei of calculi. Deposition of phosphates begins within a short time of their entry.

Symptoms.—The urine may remain normal, no symptom whatever may appear, and the individual may go about as if nothing had happened. The same absence of symptoms, we know, masks some

vesical calculi. Much depends on the shape and character of the foreign body.

But, as in the case of calculi, the rule is for the patient to have pain and frequent micturition, and possibly the discharge, at the end of micturition, of a little blood. Hard, rough, or sharp bodies are apt to excite cystitis, with its attendant cardinal symptoms. If the foreign bodies penetrate the cellular tissue and form an abscess in the pelvis, we have the local and constitutional signs of inflammation and suppuration. If they penetrate the rectum, there will probably be rectal tenesmus; if the peritoneum or small intestines, the signs of peritonitis will most likely occur.

Foreign bodies largely encrusted and forming the nucleus of a large calculus, behave like calculi formed in the ordinary way, except that there is always the risk of ulceration or perforation by the projecting extremities of the foreign bodies.

Treatment.—If the foreign body has quite recently been introduced, and it is soft and pliable, like a piece of tube, or gum-elastic catheter, it can readily be extracted by the lithotrite, no matter how it is seized by the blades of the instrument. Hard, rounded bodies can also be easily extracted by the lithotrite, either without or after breaking them into fragments. Elongated substances, whether blunt or sharp, give great trouble, because of the difficulty of catching them in their long axis. The cystoscope will often be of great value in this respect by informing us of the direction in which the body lies. Certain special instruments, such as Roberts's and Collins's "redressing" forceps, made something like a lithotrite, are very useful. They cause a long body to rotate on itself till it rests between the blades in its long axis. Some bodies, such, for example, as a hairpin, have been luckily caught by their curved ends by means of a blunt hook at the end of a flexible stem.

If the foreign body cannot be extracted by any of these methods there ought to be no delay in removing it, either by a perineal or hypogastric operation, rather than run the risk of violent or too prolonged attempts at extraction through the urethra. The hypogastric route will be the best in most cases. Different surgeons will select different routes; but whether it be by hypogastric cystotomy, or median perineal urethrotomy, the wound in the organ ought to be sutured immediately after the extraction of the foreign body, unless, owing to the presence of cystitis, there is necessity to drain the bladder.

In women it will be rarely necessary to resort to any cutting operation, the dilatability of the female urethra allowing of the extraction of most foreign bodies that can reach the bladder, by any of the methods mentioned at the beginning of this section. For treatment of fistula *see* Vesical Fistulæ, pages 952 *et seq.*

Tumours of the bladder.—Tumours of the bladder are comparatively rare. They may be malignant or non-malignant. The malignant tumours occur with greater frequency than the non-malignant.

There are some characters common to all bladder tumours. (1) Their usual *situation* is in the region of the trigone and about the orifices of the ureters; rarely, they grow from the lateral walls, and still more rarely from the antero-superior. (2) The *form* of the benign tumours is generally rounded, often polypoid or tufted; the malignant tumours are more generally spread out. (3) Their *size* is not frequently large, but varies from that of a cherry or a nut to that of an egg. Exceptional tumours have been met with as large as a cocoanut, or fœtal head, and these have generally been myomata.

Non-malignant tumours. 1. *Papilloma*.—This occurs in two forms. (a) As a circumscribed pedunculated tumour, composed of groups of long fimbriated slender processes or villi, growing from a central stalk or base. These villi consist of a capillary vessel covered by a basement membrane and a more or less thick layer of epithelium. (b) As a fibro-papillary outgrowth, with a firmer consistence and more sessile attachment than the preceding variety. Papillary processes are present, but they are less prominent, and connective-tissue and unstriated muscle-fibre enter into its structure.



Fig. 913.—Villous Papilloma of posterior Wall of Bladder with muscular Hypertrophy.

Both forms may be single or multiple, and in neither is there any infiltration of the vesical wall about their points of attachment (Fig. 913). When the villous variety is of large size the fimbriæ may get nipped in the urethro-vesical orifice during micturition, and cause great suffering.

2. *Other growths*.—Myxomata, myomata, fibromata, dermoids, and simple mucous polypi, having a structure resembling nasal polypi, are occasional rare tumours of the bladder, whilst the bilharzia hæmatobia sometimes causes fungating exudation masses of considerable size.

Malignant tumours. 1. *Sarcoma*.—Both round-celled and spindle-celled varieties of sarcoma are met with in the bladder, and occasional cases of lympho-sarcoma have been reported.

2. *Carcinoma*.—Two varieties are met with: (1) epithelioma and (2) glandular carcinoma; either soft or hard. Colloid degeneration of the latter variety may occur, but is rare. Secondary carcinoma is more frequent than primary, and may be consecutive to cancer of the rectum, vagina, uterus, or prostate. They form

prominent swellings, widely attached and infiltrating deeply the vesical coats. Their surface is granular, and in the later stages ulcerated; occasionally they present gaping ulcers with raised indurated walls.

These tumours are hard, but friable; and therein differ from softer and but little friable fibro-papillomata. They are often multiple and are most common in the trigone or base of the bladder. They develop slowly; seldom ulcerate early; and cause death before they attain any great size, sometimes even before they are followed by secondary growths in distant organs.

Symptoms of bladder tumours.—Bladder tumours are met with at all ages; the sarcomata and myxomata in children, the papillomata usually in vigorous adult life, and carcinomata between forty and sixty.

Hæmaturia is by far the most constant symptom; it is in some cases the only one. Its onset, its course, and its abundance are characteristic of tumour. It comes on spontaneously without injury, fatigue, or even movement, and it causes difficulty in micturition only when clots accumulate in the bladder, or one for a while obstructs the urethra. It may be excited by catheterism or by distension of the bladder; and rest even in the recumbent position has no effect in stopping it. After the hæmaturia has existed for hours, days, or weeks, the urine may suddenly become quite clear. Whilst the hæmaturia lasts, the urine is not equally charged with blood at each micturition, the quantity may vary from day to day, or even from hour to hour, and the urine passed at one time may be clear, whereas that voided immediately before and immediately after may be highly coloured. More blood is passed at the end of micturition than at any other part of the flow.

The quantity of blood is often exceedingly great, the urine is frequently deep-red or quite black; clots—red, black, and discoloured—may be passed, and may cause great suffering in passing; or they may be retained in the bladder and require cystotomy for their removal. When the attack has passed the patient may, if the tumour be a benign one, remain for many weeks or months without a recurrence; but if the tumour is malignant the interval between the attacks will not be very long, and will constantly tend to shorten, until the hæmaturia is always present, though still showing exacerbations. There is no relation between the size of a bladder tumour and the amount of hæmorrhage; the blood lost may be alarming, even fatal, from a small innocent growth.

Besides blood, small fragments of growth may be found in the urine, and may aid the diagnosis.

Pain is not a constant symptom, and when present is often due to cystitis. Nipping of the growth in the urethro-vesical orifice during micturition may be a cause of great suffering. In other cases pain may occur from pressure upon the nerves by infiltrating growths.

ency of micturition is present during the attacks of hæmaturia, and also if cystitis has been set up.

Rectal examination.—By palpation through the abdominal wall by rectal or vaginal examination a tumour may sometimes be felt. In such case it is probably malignant, for a non-vascular tumour such as a villous papilloma could not be discovered in this manner. Negative result of rectal examination does not rule out the presence of a tumour.

Catheterisation.—Catheterisation emits the greatest gentleness. It may give some sign by the resistance to a slight jar when the catheter touches the growth, or by a feeling of irregularity or resistance of the vesical wall on passing the point, or by exciting free hæmaturia. A fragment of the tumour may possibly be removed by the use of a catheter. The catheter (Fig. 914) in some cases gives valuable information, but is useless when there is no tumour in the bladder.

Hæmaturia.—This can generally be made pretty accurately by the examination of the urine. It is due to the recurrence of hæmorrhage in the bladder without referable movement as in cancer.

Physical examination in some cases, and cystoscopy in others, may aid in the diagnosis.

As regards the differential diagnosis between benign and malignant

tumours, the benign occur in young men, and the hæmorrhage, if severe at one time, may be absent for many weeks or months without recurring. The constitutional symptoms are not so marked as those produced by loss of blood, and there is not the rapid emaciation and debility of malignant disease. Pain is more frequent and more constant symptom in malignant disease where the growth infiltrates the walls of the bladder and extends to other structures in the pelvis. Cystitis also is much more frequent in malignant disease, because the growth may soon offer obstruction to the passage of urine at the urethro-vesical orifice, and stagnant urine with subsequent decomposition is induced.

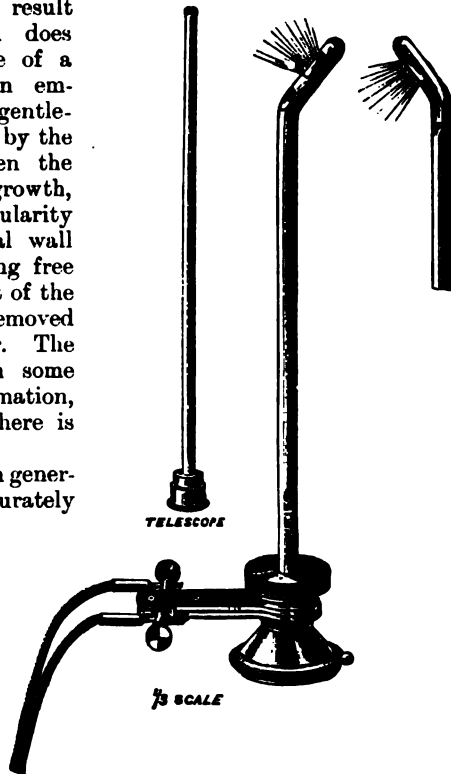


Fig. 914.—Cystoscope. (Weiss.)

Fragments of growth passed per urethram may indicate the nature of the tumour; and examination per rectum or per vaginam, and the discovery of a hard, ill-defined mass in the region of the neck of the bladder, will clinch the diagnosis.

The chief difficulty in most cases is to ascertain whether the hæmaturia is of renal or vesical origin. The absence of any tumour, resistance, pain, or tenderness about the loin, on the one hand, together with the special symptoms of vesical tumour, combined with digital examination per rectum or examination with sound or cystoscope, on the other, will generally clear up the case.

From the hæmorrhage attending acute and chronic cystitis, tuberculous disease of the bladder, calculus, and chronic enlargement of the prostate, the diagnosis will be readily made by a careful attention to the history of the case, and to the cardinal symptoms of the respective diseases.

Prognosis.—This is always serious. The malignant are unfavourable for removal, as they infiltrate the vesical walls and quickly recur. The benign tumours are often easily removable; but some, especially the villous polypi, are prone to come again. The hæmorrhage may be severe enough to kill the patient of itself, or it may so reduce his strength as to make him quite unfit to bear any radical operation for the removal of the tumour. Another source of danger is cystitis running on to pyelo-nephritis. Tumours of the bladder, if left to themselves, almost always prove fatal from one or both of these causes, though death, especially in the benign cases, may be delayed for years. Carcinoma of the bladder, only slowly and by no means invariably, infects other organs.

Treatment.—This is either palliative or curative.

The best palliative means are incision and drainage of the bladder; the excision of the tumour is, of course, the only method of cure.

It will be well to consider, first of all, the indications and contra-indications for the active treatment of vesical tumours. As hæmorrhage is, in these cases, generally a very grave symptom, the sooner it is checked the better; and, therefore, when once the diagnosis has been made, and the probabilities are in favour of the tumour being of small size or of benign nature, an operation ought not to be delayed.

And, in cases where the hæmorrhage is not so considerable, but in which the pain and frequency of micturition caused by supervening cystitis are very severe, an operation should be undertaken with the double object of relieving these symptoms, and of possibly removing the cause.

When an infiltrating growth is felt, per rectum or per vaginam or with the sound, to be involving a large surface of the bladder wall, to be infiltrating its coats, especially in the neighbourhood of the ureters and neck of the bladder, no operation whatever should be proposed unless the hæmorrhage is copious or the symptoms of cystitis severe, and then an incision for palliative purposes only should be made.

By these means we place the bladder at rest; and thus, by drainage, we remove the septic urine from an inflamed bladder, and prevent the alternation of distension and contraction of the bladder, which is the chief cause of the bleeding, we check the hæmaturia. When the disorganised state of the kidneys is unfavourable to any prolonged operation, drainage is still indicated to check hæmorrhage, or for the relief of the sufferings caused by cystitis.

Palliative treatment.—The incision into the bladder is best effected through the perinæum in the male, unless the prostate be

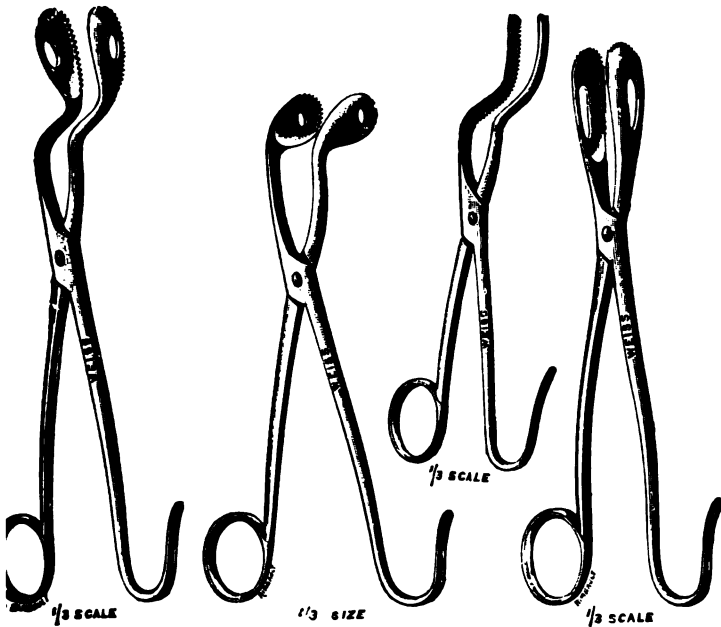


Fig. 915.—Sir Henry Thompson's Vesical Tumour Forceps. (Weiss.)

very large or the patient very stout, when the supra-pubic is the best route. In the female an incision through the anterior vaginal wall is the best method. Sutures should unite the vesical with the vaginal mucous membrane to secure a permanent opening.

Curative treatment.—The extirpation of vesical tumours has been accomplished in three ways:—

- (1) Through the urethra.
- (2) By median urethrotomy.
- (3) By supra-pubic cystotomy.

The operation per urethram is not to be recommended. Removal of small tumours with a lithotrite, after cystoscopy, has been accomplished by this method; but there is a great probability of removing only a tuft or portion, instead of the whole tumour. The perineal

operation has many objections, notably—it does not admit of inspection of the bladder, and so if growths are multiple one may be left untouched. There is only a very limited space in which to operate, and in a subject with a deep perinæum or enlarged prostate it is difficult even to reach the cavity of the bladder with the finger, and still more so to examine its cavity. On the whole, the supra-pubic method is the operation of election.

In women, urethral dilatation enables many growths to be removed through that canal. Where the growth is too large to admit of its removal by this method, hypogastric cystotomy should be performed as in men.

As regards the removal of the growth itself, several methods have been employed. The growth may be torn or twisted off with forceps (Fig. 915), or crushed with an *écraseur*. The tumour may be (1) scraped away with the curette, or (2) it may be burnt away with the actual cautery, or (3) it may be excised with a bistoury, the wound in the mucous membrane being either seared with the cautery or its edges approximated by fine sutures. The method will vary with the tumour, partly as to whether it is pedunculated or sessile, partly as to its size, and partly as to its malignant or benign nature. Undoubtedly, when possible, removal by excision with closure of the wound by sutures is the best method, and for this treatment the supra-pubic operation is required.

FISTULÆ OF THE BLADDER.

Fistulæ of the bladder.—Urinary fistulæ opening externally in the perinæum, and arising in connection with stricture and urethral abscess, have already been sufficiently treated under those headings (pages 895 *et seq.*). The succeeding remarks will deal with fistulæ connected with the bladder that open on some part of the surface of the abdomen, *i.e.* vesico-abdominal fistulæ, and those that consist in a communication between the bladder and some other viscus, *i.e.* vesico-visceral fistulæ.

1. **Vesico-abdominal fistulæ.**—Gunshot wounds have traversed the bladder, (*a*) passing in at the right or left hypogastrium and out through the opposite buttock, and urinary fistula has resulted.

(*b*) Strictures of the urethra may lead to ulceration of the parietes of the bladder, and this to an external fistula.

(*c*) An abdominal fistula may form after rupture of the bladder.

(*d*) A foreign body may find its way from the bladder by ulceration, and lead to a fistula in the groin.

(*e*) Inflammation of the peritoneum, or of some one of the pelvic viscera, may lead to adhesion and ulceration of the bladder, and then to a circumscribed abscess, which, bursting through the abdominal wall, results in an urinary fistula indirectly communicating with the bladder.

(*f*) Inflammation of the sub-peritoneal cellular tissue may in like

manner cause a urinary fistula, which may open on the abdomen or elsewhere.

2. Vesico-visceral fistulæ.—Urinary fistulæ are not infrequently established between the bladder and rectum, bladder and vagina, or bladder and small intestine, as the result of inflammatory adhesions and ulceration between those parts. Vesico-rectal fistulæ are sometimes caused by penetrating bodies passing through the anus and rectum into the bladder. They may follow punctured wounds of the rectum which do not penetrate the vesical wall, in consequence either of suppuration or sloughing.

Simple chronic inflammation, tubercle, cancer of the bowel, uterus, or vagina, and cystic and other diseases of the ovary, are common causes of these forms of urinary fistula. Stricture of the urethra, calculus, or, indeed, any cause within the bladder that excites adhesion to parts around and ulceration of the bladder walls, will conduce to them.

Treatment of vesical fistulæ.—Each case must be treated on its own merits, but a few general rules can be laid down. (1) In the first place, any cause of urethral obstruction should be removed, and a direct passage for urine obtained either per urethram by a catheter tied into the canal, or by drainage of the bladder through the perinæum. By this means the urine will, in many cases, be prevented from leaking into the fistula, which may then close, or at least be put into a condition capable of cure by subsequent erosion. (2) Any foreign body in or near the bladder, or any other cause of inflammation should be removed, if possible. (3) Abscesses and suppurating cysts in the pelvic cellular tissue must be treated on general principles. (4) All callous fistulous tracts must be laid open and scraped, excised, or cauterised.

When some part of the intestine opens into the bladder, such as the rectum, the most acute cystitis will be set up by the passage of feces into the bladder, and the patient's condition will be one of great suffering and misery. Such fistulæ are usually cancerous and admit of no radical measure. To relieve the sufferings, colotomy should be performed. In non-cancerous recto-vesical fistulæ high up, colotomy should be performed, and the bladder placed at rest by drainage through the perinæum. The fistula may then heal, and if this result is obtained, the colotomy wound may be closed by a subsequent operation.

In cases where fistulæ persist in spite of every effort to close them, the skin must be protected from excoriations from the contact with urine, and the parts kept sweet and clean by antiseptic dressings frequently changed. When the fistula opens by a wide and single orifice, and has a direct track to the bladder, the adjustment of an urinal is often easily accomplished.

Urachal fistulæ.—The urachus is that part of the allantois between the summit of the bladder and the umbilicus which is normally closed about the seventh month of fetal life and at birth is represented merely by a fibrous cord. If this portion of the

allantois remains wholly, or in greater part, patent, an *urachal fistula*, or communication between the bladder and umbilicus by means of the urachus, will, in the first instance certainly, and in the latter case probably, be brought about.

When an urachal fistula exists, the child will on micturition pass a certain amount of urine through the umbilical opening. The umbilical opening will present certain characteristics. In some cases there is a peculiar button-like papillary projection at the umbilicus, with an orifice at its summit through which a probe may be passed; or the urine may escape at several points on the surface of a hernial protrusion, the external covering of which is mucous membrane instead of skin. The orifice may be a mere deficiency in the linea alba, or situated in the cup-like depression of the navel.

Urachal fistulae may be congenital or non-congenital. In the congenital form the urachus is patent throughout, and the leakage of urine may commence as soon as the umbilical cord separates. It may or may not be associated with dilatation of the ureters and kidneys, or with urethral obstruction and hypertrophy of the bladder. The urachus may subsequently be shut off from the bladder, and then an urinary may be converted into a pus-secreting fistulous tract.

Mode of origin of non-congenital fistula.—When the lower end of the urachus remains open, some of the urine is forced into it at each act of micturition, and especially at the commencement of the act. If the bladder becomes after a time the seat of inflammation, the difficulty and straining in micturition will increase the dilatation of the urachus, as it does that of the ureters and pelves of the kidneys. Again, if, as Luschka seems to indicate, the vesical orifice of the urachus becomes very minute, or even closes, we see how the tube of the urachus may be converted into a shut sac; and then if any urine or mucus is enclosed within it, inflammation and abscess will be caused, and the abscess may either burst spontaneously, or be opened by the surgeon, at the umbilicus, where it will point. In either of these ways a non-congenital fistula may be formed, quite independently, as it would seem, of any mechanical obstruction at the neck of the bladder or in the urethra.

Complications of urachal fistula.—Some of the complications are causes, others are results, and others again merely coincidences. Of the first set there are polypus of the bladder, urethral calculus, phimosis, congenital stricture, and everything that prevents the free discharge of urine along the natural passage. That these act only partially as causes is clear, as there must be also an imperfect closing of the urachus to admit of a true urachal fistula. When this patency does not exist, the bladder, ureters, and kidneys may all become sacculated, without any reopening of the urachus. This is proved by cases of congenital hydronephrosis.

Prognosis.—When the fistula is congenital and caused by some obstruction to the outflow of the urine, the prognosis is unfavourable, as death from renal disease is likely to result, unless the cause of the obstruction can be removed, like phimosis or an urethral calculus.

When the fistula is non-congenital, and follows cystitis or abscess, the health of the patient will have been greatly destroyed, in all probability, before the fistula is established, and death will occur subsequently from exhaustion, cystitis, or pyelo-nephritis. In cases of simple patency of the urachus without urinary obstruction there is no reason why life should be interfered with, though the comfort of the individual necessarily is so.

Treatment.—There are two clear indications—namely: (1) to remove any source of obstruction to the natural discharge of urine, and (2) to close the fistula when there is nothing (like suppuration or obstruction) to require it to be kept open. When phimosis exists circumcision should be performed. When a calculus is present it must be, of course, removed. If cystitis is a complication, irrigation of the bladder or drainage by means of dilatation of the urethra in the female, and median external urethrotomy in the male, may effect a cure of the fistula.

With a view to closing the umbilical orifice of the fistula, different methods have been tried, and each may succeed, though all may fail. If the opening is a vent for pus, or for urine which cannot, or can only with difficulty, pass through the urethra, no attempt at closure ought to be made. When the opening is upon a papillary outgrowth, it is sometimes sufficient to apply a ligature around the base of the papilla, which in a few days will then dry up and fall off, and the fistula be permanently closed. In other cases, again, the plan of dissecting off the skin around the opening, and bringing the raw surfaces together with hare-lip pins should certainly be tried. (See also page 601.)

Cysts of the urachus.—Besides the permanently tubular condition of the vesical end of the urachus, to which attention has been drawn above under the heading of urachal fistula, pouches or cyst-like dilatations of the urachus are sometimes found in the abdominal wall, or at the umbilicus. These cysts are the results of the imperfection of the embryonic changes which should entirely obliterate the tube of the urachus. They are situated in the cellular tissue immediately outside the parietal peritoneum, and though often small, they may attain such a size as to simulate ovarian cystic disease. Their contents vary, being either mucus or mucus and epithelium, or urine, or pus; their growth is slow and painless; and they may be either single or multiple. The cyst wall is composed of a mixture of fibrous and non-striated muscle tissue, covered with cells like those lining the interior of the bladder and the allantois.

Treatment.—There is much risk in excising large extra-peritoneal tumours from the abdominal parietes. Incision and drainage of these tumours is to be preferred to their removal, and this treatment has certainly been the more successful. (See also page 602.)

LII. INJURIES AND DISEASES OF THE TESTES, SCROTUM, AND PENIS.

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INJURIES AND DISEASES OF THE SCROTUM.

Injuries of the scrotum.—Wounds of the scrotum may be incised, contused, lacerated, punctured, or gunshot; they may extend through the tunica vaginalis, and may be followed by the protrusion of the testicle.

Contusions of the scrotum are often followed by the escape of a very large amount of blood into the loose connective tissue beneath the skin and dartos. In this way a considerable purple-coloured swelling (scrotal hæmatocele or hæmatoma) is formed, which may be mistaken for an ordinary vaginal hæmatocele. Indeed, the one may be produced by the same violence that causes the other; and in some instances the vaginal hæmatocele communicates through a rent in the tunica vaginalis with the scrotal hæmatoma.

The *treatment* of wounds, contusions, sloughing, and abscess of the scrotum is the same as that required for the corresponding conditions in other parts of the body. Incised and lacerated wounds heal very rapidly, the contraction of the dartos tissue favouring the apposition of the divided edges. Sutures, however, are advantageous, though primary union is often obtained without them.

The scrotum is occasionally cleft, as in Fig. 916. In such cases the penis is often very small, and the testes which are contained one in each sac of the scrotum are also often under normal size.

Prurigo and eczema of the scrotum arise in children from the dribbling of urine due to phimosis, stone in the bladder, stony, and incontinence from other causes. Eczema occurs also in adults from the constant wetting with urine in some cases of stricture and enlarged prostate; and it is frequently caused by diabetes and disturbances of the digestive organs. These affections are apt to spread to the thighs, perineum, and hypogastrium.

The *treatment* must be directed to the cause.

Parasites.—The pediculi pubis often invade the scrotum. They are to be seen by the naked eye, and their eggs are found as minute whitish masses on the hairs of the part. A solution of corrosive sublimate (2 grs. to 3j of water) or mercurial ointment is an effective remedy for these loathsome lice.

Varicose veins.—The veins of the scrotum sometimes become greatly enlarged, especially in persons whose dartos tissue has been weakened by age, debility, hernia, varicocele, or hydrocele. Cold bathing and a suspensory bandage are the remedies.

Emphysema

of the scrotum is present in gangrene of the scrotum when putrefactive changes occur in the dead and dying tissues. Simple emphysema has been sometimes produced by maligners and showmen artificially. This condition can be easily and painlessly produced by inserting the point of a small tube or syringe through a small hole in the skin and blowing in air. The air is very readily absorbed, and the parts restored to their normal size.

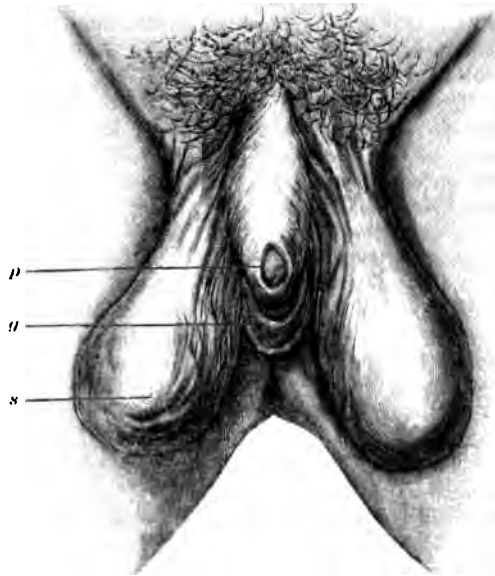


Fig. 916.—Cleft Scrotum. (After Ashhurst.)

p, ill-developed penis; s, cleft scrotum containing small but normal testicles; g, orifice of genito-urinary sinus.

Œdema of the scrotum occurs either as a primary affection, from erysipelas or some form of local irritation, in which case its origin is always inflammatory; or as secondary to disease of some other organ, such as the heart, kidneys, or liver—in cardiac, renal, or hepatic dropsy. It occurs, too, as a secondary condition in epididymo-orchitis, and from obstruction to the circulation by inguinal and pelvic swellings and tumours.

Secondary œdema of the scrotum is distinguished from inflammation by the absence of tenderness and of constitutional symptoms, although when the œdema results from epididymo-orchitis, there are the tenderness and feverishness of the inflamed testicle.

Treatment.—The treatment of primary œdema resolves itself

into that adopted for the inflammation of which it is a sign. In œdema unaccompanied by inflammation, rest and elevation will sometimes cause the effusion to vanish. In extreme cases Southey's tubes, or a few minute punctures with a tenotomy knife, will allow of the fluid draining away. It is seldom necessary or desirable to make large incisions.

Inflammation of the scrotum is always the cause of primary œdema. It is generally erysipelatous in character, occurs in the intemperate and debilitated, and is usually excited by the irritation due to dribbling of urine, or from some puncture, abrasion, eruption, boil, or sore on the surface of the scrotum. Inflammation of the scrotum may be started by an acute phimosis due to gonorrhœa or to chancre. The local symptoms are frequently accompanied by much constitutional disturbance.

The inflammation usually terminates by resolution, but suppuration is not uncommon. Occasionally, owing to the rapidity and excess of the exudation, extensive sloughing of the subcutaneous tissue occurs, leaving the testicles more or less exposed, and sometimes even gangrenous.

The *treatment* is, as a rule, simple and successful, and consists in keeping the patient in bed, elevating the scrotum, applying some warm, soothing lotion, such as Goulard water; and administering at first a brisk purge and subsequently an effervescing saline mixture. Under this treatment the symptoms usually subside in three or four days, and the patient is quite recovered by the eighth or tenth day.

When, however, the symptoms do not yield, and suppuration is threatened, a few incisions should be made to relieve tension and prevent sloughing, and then fomentations of weakly carbolised Goulard water should be applied. If sloughs occur, their separation should be hastened by charcoal or carrot poultices, and all parts as they become loose should be removed with scissors. As soon as the dead tissues have come away, even though the testicles are left in great part bare, cicatrisation rapidly ensues under a dressing of an antiseptic oil or ointment and a general tonic and stimulating treatment.

Epithelioma of the scrotum. Ætiology. — This is commonly named "chimney-sweep's cancer," or "soot cancer," because it was most commonly found in chimney-sweeps, and was then due to the irritation set up by constant friction between sooty trousers and perspiring scrotum. Soot, when applied constantly to other parts of the body, has been known to excite epithelioma. Epithelioma scroti occurs in other than sweeps, especially in those whose occupation favours the saturation of their clothes with some irritant. Thus it has been noticed amongst the employes at gas works, tar works, and chemical manufactories.

Scrotal epithelioma is rare in comparison with epithelioma in other situations. The proportion of sweeps affected was always comparatively small, so that, doubtless, a predisposition on the part

of those affected is required, as well as the action of the special irritant. Nor was the disease ever very common, and there is good reason for believing that it is becoming appreciably less so than formerly, owing to the great precautions in regard to baths and clothes which of late years have been taken by workers in these materials.

The action of soot in causing epithelioma is very slow, and consequently the disease has been very rarely indeed met with before middle life, even in men whose childhood and boyhood have been passed in constant contact with soot.

Scrotal epithelioma is very slow in its progress, seldom proving fatal in less than six or eight or more years; often existing a very long time, even several years, before implicating lymphatic glands, and even at the last not extending beyond the nearest group of glands. Secondary affection of the glands may be deferred for several years, and when it occurs it may be not till years after the excision of the primary affection.

Symptoms.—It generally begins as a small single wart or pimple on the most dependent part of the scrotum. In other instances it commences as a horn-like excrescence or papilloma, or as a small subcutaneous nodule in connection with a sebaceous gland or hair follicle. At first the disease, in whatever form it begins, appears to be of a simple nature, and may so remain for a long time; but sooner or later it softens, becomes more vascular, and excoriates or ulcerates, and then becomes covered with a thin scab at one part, whilst perhaps it sloughs at another, and, maybe, sends out a cauliflower-like excrescence at another. The sore usually yields a thin ichorous discharge; its edges are irregular, hard, and everted, and its base is also much indurated. As the disease advances, it does so in depth as well as in area; and though it has little tendency to invade the testicle, it may destroy the underlying part of the tunica vaginalis, and spread beyond the scrotum to the penis, groins, or perineum.

Treatment.—Excision, wide and free of the disease, at as early a period as possible, is the only proper treatment. When the inguinal glands are invaded, they, too, should be excised. When the disease has advanced beyond the limits of an operation, treatment must be directed towards the prevention of suffering by local anodynes and morphia, whilst antiseptic irrigations and dressings are employed to keep the parts sweet and clean. The prophylactic treatment comprises strict cleanliness both as to clothes and skin, and the removal of any wart or papilloma before it becomes cancerous.

Other forms of malignant disease of scrotum.—These are all very rare. Medullary carcinoma, scirrhous, a mixed adeno-chondrosarcoma and melanotic sarcoma have all been described.

Treatment.—These growths should in every case be removed by free excision at the earliest possible opportunity.

Non-malignant tumours of the scrotum.—There are several varieties, but all are rare.

Angiomata or vascular growths.—Scrotal nævi are not

very uncommon in infants. They should be treated as are nevi in other parts. If left alone, they may undergo cystic, fibroid, or fatty change, and in these forms are occasionally met with in later life.

Congenital venous angiomas have also been described, and I have had two cases in my own practice.

Cystic tumours.—These are all very rare.

Two forms of sebaceous cysts of the scrotum are described. One is a simple dilatation of a sebaceous follicle; the other is a dense sac of connective tissue containing clear serous fluid. The latter variety is often multiple, and varies in size from a swanshot to a hen's egg.

Hydatid cysts of the scrotum form another rare variety of cystic disease of the scrotum.

Urinary cysts.—These are caused by the gradual escape of a small quantity of normal urine through an abnormal opening in the urethra. In some cases an abscess has preceded the formation of the cyst.

The best treatment for the sebaceous form of cysts and the hydatid cysts is removal. The urinary cysts should be laid open and scraped.

Lipomata, both of the encapsuled and diffuse varieties, have been met with. The encapsuled lipoma is apt to give rise to an imperfect sense of fluctuation in some cases where the usual lobulated outline cannot be distinguished, and so to give rise to mistakes in diagnosis.

Fibromata are a rare form of scrotal tumour which sometimes attain immense size. Twenty-three and twenty-four pounds, and in one case forty-four pounds, are weights that have been reached by these tumours. They occur as single tumours of varying consistency, usually lobulated and sometimes containing cartilaginous, fatty, myxomatous, or sarcomatous elements.

Chondromata form the rarest class of scrotal tumours. They may grow to a very large size.

Treatment.—All these forms of solid tumours should be removed when possible. In diffuse lipomata, when excision is impossible, constitutional treatment should be employed. Malt liquors and starch food should be forbidden, and sulphide of calcium tried. Fibromata may not improbably recur after removal.

Elephantiasis scroti.—This is an affection of India, Arabia, China, West Indies, Syria, the Delta of the Nile, and other hot countries, but is rarely seen in Europe or North America.

Pathology.—It is a chronic inflammatory disease associated with much œdema, set up by repeated attacks of erythema, and resulting in chronic hypertrophy of the skin and cellular tissue. This occurs in some cases to be due to obstruction of the scrotal lymphatics by the *filaria sanguinis hominis*. In other cases simple inflammatory matting or cicatricial contraction of the lower abdominal lymphatics, or of the thoracic duct itself, may occasionally originate the disease. Syphilis has been asserted to be the primary cause in a few instances.

whilst in others no satisfactory cause of origin can be ascertained. Heat and moisture seem to have a powerful influence in determining the production of the disease.

The chief alteration in the tissues of the scrotum is the enormous hypertrophy of the subcutaneous connective tissue, which becomes so dense as to cut almost like cartilage. Lymphatic vessels, dilated or varicose, and filled with a gelatinous fluid, are found in this œdematous, dense white fibrous, and elastic tissue, and the lymph spaces of the cutis are increased in size. The veins are enlarged, tortuous, and patulous when cut. The testicles lie embedded in the posterior part, and the penis, covered with similarly hypertrophied tissue, is buried in the anterior part of the swelling. Vaginal hydrocele is commonly associated with the elephantiasis, and hæmatocele occasionally so. The testicles are unchanged, but the spermatic cord is much elongated by traction, and the cremaster much thickened.

Symptoms.—In the early stages elephantiasis is associated with frequent attacks of feverishness, local heat and pain, by erysipelatous œdema, and swelling of the inguinal glands. Each attack leaves the scrotum more enlarged, and, when once thoroughly established, the scrotal enlargement goes on increasing without fresh pyrexial attacks. The shape of the swelling is pyriform or ovoid, having a broad, thickened peduncle extending the whole area of the perinæum from anus to pubes. Owing to the drag upon the skin of the hypogastrium, the hair of the pubes is spread out over the front and upper part of the sides of the tumour; and the penis is gradually drawn in till it is represented only by an umbilical-like aperture. The surface of the skin may be smooth, though thickened and indurated, but it is more generally rugose, and fissured, and superficially ulcerated between the rugæ. Crusts cover the superficial ulcers, and an offensive sanious discharge oozes from beneath the crusts. Sometimes there is a discharge of lymph from some of the more prominent knots or rugæ, and in some cases sloughing occurs, and the testicles become thereby exposed. When not inflamed or ulcerated, the skin is very little sensitive. The chief, almost the only, inconvenience is the dragging and great weight. The weight sometimes attained is enormous, amounting to 120 lbs., and even to 200 lbs.

Prophylactic treatment.—For culinary and drinking purposes only boiled water should be used, and stagnant water should be avoided even for washing. In fact, every prophylactic measure against the *filaria sanguinis hominis* should be taken.

Operative treatment.—The operation should be performed under the best hæmostatic and aseptic conditions. Turner's (of Samoa) clamp, consisting of two parallel wooden bars approximated by screws, or Esmarch's bandage, should be applied; then the body of the penis, and subsequently the testicles, should be dissected out, and the whole of the coverings of these organs, as well as the raphe of the perinæum, should be dissected away. No portion of the

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diseased tissues should be left behind, otherwise recurrence is certain. All bleeding vessels should be ligatured or twisted. The wound must heal in chief part by granulations, and, whilst doing so, care must be used to keep the penis free. In successful cases the sexual functions, as well as the general health, are restored.

Lymph scrotum.—This is a condition allied to elephantiasis scroti, and probably dependent on the same causes, which is only met with amongst those who have resided in countries where elephantiasis is endemic.

The patient, having been the subject of previous malarial attacks, gets his scrotum and inguinal glands, and perhaps, too, his testicles, inflamed during a paroxysm of fever. Then an abscess forms in the scrotum, and vesicles occur upon its surface and burst, discharging straw-coloured, serous-looking fluid. The discharge continues for a few days; the scrotal swelling diminishes; the discharge ceases, reaccumulates, and refills the vesicles, which again burst and go through the same process. In all cases the inguinal glands enlarge. The treatment consists in excision, as in the case of elephantiasis scroti.

Scrotal calculi.—These consist either of uric acid or of phosphate of lime, and are formed by deposition from the urine, either within the urethra or along some fistulous track. They have been met with after many years of existence and growth, and in some cases of large size. Having made their way by ulceration through the urethra, they increase by the deposition of salts from the urine which escapes through the urethra fistula.

INJURIES AND DISEASES OF THE TESTICLE

Abnormalities in development and transit of the testicle.—Abnormalities of the testicle have relation to either the development or the transit of the organ. The two classes are closely related to each other: any fault in descent interferes with the proper development, and conversely any defect in its development may interfere with the descent of the testicle.

Polyorchism, or the presence of a supernumerary testicle, is undoubtedly rare, and in the majority of the cases in which a third testicle has been supposed to exist it has turned out to be an encysted hydrocele, or a movable fibrous body in the tunica vaginalis, or an omental hernia.

Anorchism is the absence of both testicles. **Momorchism** is the absence of one testicle. These conditions are rare, and are sometimes erroneously thought to exist when, in reality, the testicle is either retained, imperfectly descended, or atrophied. Either the testicle as a whole, including epididymis and more or less of the vas deferens, may be absent; or the testicle proper may be absent, the epididymis and the rest of the parts being present; or the epididymis and vas may be absent and the testicle proper may be present.

These deficiencies of part only of one testicular apparatus can be easily understood if it be remembered that the vasa efferentia, the epididymis, and the vas deferens are derived from the Wolffian body and its duct, whereas the testis is developed separately from the genital mass. When these abnormalities affect one organ only, the scrotum on the same side is usually present, though probably not perfectly developed. In some cases of monorchism, malformation or absence of the ureter and kidney on the same side has been observed. In some cases of anorchism the external genitals have existed only in a rudimentary state, and abnormalities affecting the urinary apparatus and the rectum and anus have co-existed with those of the testis.

In monorchism, if the single testicle is well formed and in normal position, the sexual function and bodily and mental powers are unaffected. In anorchism (both testicles absent) the individual is impotent, sterile, with impaired energy and feeble mental and physical powers, and the puerile manner and puny voice of the eunuch.

Retained and misplaced testis.—One or both testicles may be retained at any point in their transit from loin to scrotum. Such a condition is known as “undescended testis”; but if the testicle be not only undescended but has assumed some abnormal situation, the condition is then known as “ectopia of the testis,” and the testicle is said to be “ectopic.” For both testicles to be retained or ectopic is a very rare occurrence.

Ectopia testis occurs in three situations: (1) The testis, having traversed the inguinal canal, goes to the perinæum instead of to the scrotum—*perinæal ectopia*; this is the most common form. (2) The testis leaves through the crural instead of the inguinal canal, and remains near the saphenous opening—the *crural ectopia*; this is a very rare variety; and the rarest of all, (3) the *peno-pubic ectopia*, is where the testis is situated in front of the pubes at the root of the penis.

In the perinæal ectopia the testis occupies a pouch beneath the deep layer of the superficial fascia, and is surrounded by its tunica vaginalis. The scrotum of the corresponding side is generally ill-developed. The cord can be traced down to the testis along the outer side of the scrotum, and in an adult the testis and epididymis can be distinguished. It is usually congenital, but a testicle that for years has been retained in the inguinal canal has been known subsequently to migrate into the perinæum.

Causes of undescended and ectopic testes.—Many are ascribed, but few are known. Intra-uterine peritonitis, contracted size of external ring, ill-development of inguinal canal, a long mesorchium, absence or malposition of one or more of the attachments of the gubernaculum testis, shortness of the vas deferens, or of the vessels of the cord, the excessive size of the epididymis, and the forcible contraction of the cremaster, have all been regarded as causes, and illustrative cases have been published.

Retained and ectopic testicles, though small, ill-developed, and sometimes the subject of fibrous and fatty degeneration, are by some regarded as being invariably functionless. It is probable that a misplaced testis is at first normal in structure, but that by pressure and repeated attacks of inflammation it degenerates and becomes sterile. Even then the man need not be sexually incapable. This is a question sometimes of importance in medico-legal cases.

Complications of misplaced testes.—The complications of misplaced or retained testes are hernia (either congenital or acquired), inflammation, gangrene, peritonitis, atrophy, hydrocele, hæmatocele, and in adult life malignant disease. A testicle, whether retained or ectopic, is liable to attacks of inflammation (epididymo-orchitis) from blows, strains, sudden twists of the body, or from muscular contraction, from extension of inflammation, from a local peritonitis, from gonorrhœa, or the passage of instruments. A testicle retained in the upper part of the canal or in the abdomen, if inflamed, may set up a local or general peritonitis, and when retained in the inguinal canal it may simulate strangulated hernia.

Treatment of misplaced testes.—Misplaced testes are very apt to give trouble on account of their exposed position, which renders them liable to attacks of inflammation on slight provocation. The testicle retained in the inguinal canal is unable to slip out of harm's way on the receipt of a blow on the groin, and being driven back against the firm tissues beneath it, is easily contused. If such a testicle becomes inflamed, the treatment should at first be palliative, as for ordinary epididymo-orchitis. To prevent the occurrence of inflammation the testicle should be transplanted by operation to, and fixed in, the scrotum by one or more sutures. This, however, should be limited to cases where the testicle, though small, is of fair consistence, and where the cord can be sufficiently elongated and the scrotum is sufficiently well developed to admit of such transplantation. When any of these conditions are absent, the testicle should be removed. When complicated with hernia, the treatment varies in different cases. If the rupture can be returned, and the testis pulled down, Wood's truss, with a horse-shoe shaped pad, should be worn continuously. When this cannot be effected, or the testicle gives rise to trouble by repeated attacks of inflammation, a radical operation for the cure of the hernia should be performed, and the testicle at the same time either transplanted into the scrotum, or excised, according to the requirements of the case. When complicated by malignant disease, castration is the only treatment.

In some cases of imperfectly descended testicle in children, adhesions are stretched and the cord elongated by the nurse or surgeon daily dragging lightly upon the testicle with the finger-tips, pressing it towards the scrotum and retaining it there for four or five minutes at a time.

Torsion or axial rotation of the spermatic cord.—This is a rare condition, in which the spermatic cord is twisted or rotated upon itself, thereby causing acute strangulation of the

testicle. It is generally associated with imperfect descent of the testis. No satisfactory account of the cause of axial rotation has yet been given which will apply to all the recorded cases. The absence of a mesorchium, or an extreme length or laxity of the mesorchium, has been supposed to account for some cases; twists and other violent efforts for others; but in others, again, no cause seemed forthcoming.

It is very doubtful whether, in a normally descended testicle, with a normal mesorchium, the spermatic cord can undergo rotation. The testicle may be twisted either towards or away from the median line. In all cases the epididymis has been more swollen than the testis; the testis itself in some cases has appeared normal to the naked eye. A good deal of blood may be extravasated into the epididymis, and between the layers of the peritoneum forming the mesorchium. The testis may be black and gangrenous, as may be also the epididymis; and the latter may be constricted into lumps or masses by tight bands of tissue.

The *symptoms* have in all cases been pretty much the same—namely, the more or less sudden occurrence of pain and swelling in the groin attended with vomiting. In several instances the true nature of the swelling has only been discovered on performing an exploratory operation.

Diagnosis.—Most cases have been diagnosed as strangulated hernia, and in many instances the surgeon can only be sure of the condition by cutting down upon the swelling. In other cases the diagnosis can be made by (1) the empty condition of the inguinal canal; (2) the unobscured cord; (3) the imperfectly descended testis; (4) the absence of the testis on one side of the scrotum; (5) by the epididymis being in front of the testis; and (6) by the existence of a lump or knot in the cord with swelling between the knot and the testis, and the natural state of the vas deferens above the knot. If the cord can be untwisted and the symptoms thereby at once relieved, the diagnosis is complete.

Treatment.—If the cord, either without or after exposure by operation, can be untwisted, and if the testis or epididymis is not in a state of gangrene, it will not be necessary to remove the organ. If the twisted cord cannot be satisfactorily put right, or if gangrene is threatened, or actually exists, it will be best to tie the cord high up and excise the swollen, discoloured and hæmorrhagic mass. If the testicle has never properly descended, and cannot be fixed in the scrotum, it is likely to be a constant source of inconvenience and trouble, and had better in all cases be removed.

Abnormal position of the testis in the scrotum.—The testicle is occasionally anteverted—*i.e.* the posterior and attached border becomes anterior; so that, if a hydrocele occurs, the testicle is situated in front and the tunica vaginalis behind and below. The testis is also sometimes, though very rarely, inverted—*i.e.* its upper end is below, so that the vas deferens starts from an epididymis, the tail of which is above the testis. In these

cases the vas is shorter than normal. The relation of the tunica vaginalis to the testis is not affected by this inversion of the organ, as it is in the condition of anteversion. Imitating this condition, I have sometimes fixed the testes thus in transplanting the undescended organs to the scrotum, after detaching the vas from the back of the epididymis.

HYPERTROPHY AND ATROPHY OF THE TESTIS.

Hypertrophy may occur when the other testicle has become atrophied, or has failed to be developed, or after removal of the other testicle. In some cases in which one testicle has been retained in the abdomen, or has been absent altogether, the other testicle has been more than double the normal size and weight.

Atrophy occurs in two forms, as the result of different kinds of changes :

(1) In those cases which are due to inflammation, whether traumatic, syphilitic, or otherwise, there is a marked shrinking and sclerosis of the testis ; all the connective tissue of the gland—perilobular, peritubular, and perivascular—is increased and shrunken, and by its compressive effects the secreting structure is destroyed. The gland shrinks to the size of a horse bean, or even less, and is hard and nodular ; and on section shows nothing but bands of connective tissue, with, perhaps, here and there, a few scattered seminal tubules.

(2) The other form of atrophy is much rarer, and results from the cutting off of the arterial supply, or from nerve lesions, and not from inflammation. It is of the nature of a fatty degeneration of the glandular structure, unaccompanied by any sclerosis of the connective tissue. The testicle in this form of atrophy becomes much reduced in size, but is soft and flabby instead of being hard and nodular. On section, the gland is anæmic ; tubules are present, but in different stages of fatty degeneration ; and fatty tissue may also be found beneath the visceral tunica vaginalis between the epididymis and back of the testis.

In both forms the epididymis shares in the atrophy. With the shrinking of the organ, the vessels and nerves of the cord diminish in size, and the cremaster disappears.

Arrest of development is to be distinguished from atrophy of a once well-formed organ. This arrest is commonly found in undescended and ectopic testes.

The common sequelæ of atrophy of the testis are neuralgic pains and sterility ; and in some cases the development of certain female characteristics, such as enlargement of the mammæ and a feminine, fat, plump outline of figure.

The treatment can only be preventive ; the cause should be removed when possible.

INJURIES OF THE TESTICLE.

With the exception of contusions, traumatic lesions of the testis are rare.

Punctured wounds.—These are almost always of surgical origin, their most frequent cause being puncture with a trochar and cannula in paracentesis for hydrocele. A very acute pain, in some cases inducing syncope, and the escape of a little blood through the cannula as soon as the trochar is withdrawn, and then of blood-stained hydrocele fluid as soon as the cannula, withdrawn from the tunica albuginea, has entered the vaginal sac, are the indications of this accident. Acute inflammation is likely to follow, especially if the tubular structure of the gland has been at all broken up by the vulnerating body. Suppuration and gangrene have been described as actual consequences of punctured wounds; but they are quite exceptional, for, as a general rule, unless the organ is previously diseased, rapid recovery is the result. In many cases little or no inflammation whatever is excited.

Incised wounds.—Superficial incised wounds heal, as a rule, by first intention, even without the introduction of sutures; but if the wound deeply involves any considerable length of the organ, it will subsequently atrophy, as the glandular tissue is strangled by the contraction of the cicatricial material. Suppuration is very improbable, unless the incision is made with a dirty knife, or the wound is allowed to become septic. Unless the testicle is tuberculous, or otherwise partly disorganised prior to the injury, hernia or fungus testis does not occur.

Contused wounds.—These are the most frequent of the traumatic lesions of the testis. They are caused by blows, falls astride, kicks, squeezes, and other forms of violent pressure.

Symptoms.—These are acute, insupportable pain, often severe enough to produce syncope. Death from shock, even, may be the result—sometimes almost instantaneously, more often perhaps after the lapse of several hours. The pain is not seated only in the testicle injured, but radiates to the thigh and extends along the cord, often reaching as high as the kidney in the loin.

Prognosis.—Though fatal results have occurred, they are very rare. The usual course is for the pain to pass quickly, the swelling to disappear by degrees, and the attack to be of but little immediate importance. The subsequent effects are those which give gravity to these injuries. Atrophy so commonly follows that it is to be expected in any case, and in persons with a tuberculous tendency these injuries often induce tuberculosis of the testicle.

Suppuration is very rare, and need not be anticipated if the organ prior to the injury was quite healthy. It is orchitis followed by atrophy, or atrophy even where the inflammation has been too trivial to attract notice, which is the common result of injury in men of all ages. In less than six weeks the body of the testis may be no larger than a haricot bean, may be soft and flabby, with its tunica albuginea wrinkled and clearly too large for its contents, and on section of the testicle proper the gland tissue looks anæmic and opalescent or milky white in colour. The epididymis for a time is frequently but little, if at all, changed.

Diagnosis.—The marked feature that distinguishes traumatic

orchitis from inflammation of venereal origin is the complete immunity of the epididymis in traumatic cases. The swelling at first is entirely confined to the body of the testicle, and though later the epididymis may also suffer, it is never affected to any marked degree. There may be hydrocele of the tunica vaginalis, of either slight or very pronounced dimensions.

Treatment.—The treatment of injuries to the testicle is very simple—namely, rest in bed, cold applications, and the general treatment appropriate for orchitis. Punctured and incised wounds soon heal, and sutures are rarely required even for long incisions. For contused wounds sutures are useless. In very severe cases of the third degree, where the gland is completely crushed or pulped, primary castration is proper.

Traumatic displacement or acquired ectopia of the testis.

—Traumatic or acquired ectopia is caused either by injury or by sudden and forcible contraction, voluntary or involuntary, of the cremaster muscle, by violent effort during coitus or lifting some heavy weight. The accident is a rare one, but well-recognised cases have been recorded. From one of the above-mentioned causes the testicle is forced into some abnormal position, where it may become fixed by inflammatory adhesions. If displaced into the abdomen, severe peritonitis may ensue. The form of injury most likely to cause displacement of the testis is direct violence applied to the testicle through the scrotum, as by the passage of a carriage wheel over the scrotum; and two cases of this accident have been recorded.

Treatment.—In traumatic displacement immediate reduction should be effected by manipulation if possible. If not possible, gentle massage may succeed at a later stage; and if it does not, the gland may perhaps be replaced by operation. Strapping, or a bandage, or one or two sutures, should be used to keep the testicle in place after reduction has been accomplished. If the testicle becomes inflamed, or adherent in its faulty position, castration should be performed.

FUNCTIONAL DISORDERS IN RELATION TO THE TESTICLES.

Neuralgia of the testis is like neuralgia of the face, characterised by sudden severe and paroxysmal pain, and may be due to a cause situated in the testicle itself, or in some distant part.

Causes.—Those situated in the testicle are contractions of inflammatory deposits, minute abscesses, fibrous bodies in the tunica vaginalis, small encysted hydroceles, progressive atrophy, a small new growth, *e.g.* fibro-myoma, or injury to the vas deferens.

Causes situated at a distance from the testicle are irritation in the prostatic urethra, stone in the bladder or kidney; oxaluria, lithiasis, gout, rheumatism, and extreme nervous depression associated with phosphuria and constipation, or some fissure or ulcer of the anus or rectum, are also common causal conditions.

Treatment.—Where possible, the cause should be ascertained

and removed; where this is not possible, the testis should be supported in a suspender, the bowels should be daily evacuated, the diet regulated, rest in the horizontal position enjoined, and ice or hot fomentations, or some anodyne liniment—such as opium, belladonna, or atropine—should be applied locally. Morphia may have to be injected occasionally. Division of the nerves of the spermatic cord and castration have been occasionally practised, but are not to be recommended except in the rare cases of neuralgia from a new growth, or from the contraction of some old inflammatory thickening in the epididymis or testis, which no other remedies have succeeded in improving.

Masturbation.—This is a habit only too rife at puberty and early manhood as the result of the natural onset of sexual feelings and desire when not controlled, but it may be formed even in quite early childhood as the effect of some pathological irritation in the penis or rectum of the child, *e.g.* a long tight foreskin, thread-worms, or of the wanton excitement of the child by the nurse.

The effect of masturbation, or of premature stimulation of the sexual organs, is shown on the nervous, muscular, and general systems. The child becomes irritable, restless, excited, or languid, and prematurely old in appearance and ways; his limbs grow weak and flabby; his appetite fails or varies; he looks pale, pinched, and pasty. The special senses may become dull or temporarily defective. Epilepsy, tuberculous disease, or general physical and nervous prostration may be induced. In the young adult, there are added to the physical changes the effects that spring from the consciousness of wrong-doing, or at any rate, of a secret habit. His look is downcast or abashed, he is taciturn, solitary, nervous, hesitating, or timid. His eyes are often strained, the cornea of unnatural brightness, the conjunctiva bloodshot, and his skin is often bedewed by a greasy, clammy sweat.

Yet many who confess to a former considerable practice of masturbation are physically robust, mentally active, and open and courageous in manner. The natural temperament of the individual will greatly modify and influence the effect wrought upon him by this demoralising and mischievous habit.

Treatment.—This resolves itself into moral and medical. To take the last first. Any local cause of irritation must be removed; circumcision should be performed, and, with the view of breaking the habit, the skin of the penis may be painted with nitrate of silver or brushed with blistering fluid. The bowels should be regulated, the bladder emptied at once on waking from sleep, cold or nearly cold sponging and bathing should be daily employed, and the general health improved by wholesome diet, fresh air, healthy exercise, and proper studies and amusements.

The moral treatment consists in properly guarding and over-looking his habits, his friendships, his occupations; not in a suspicious, mistrusting, and officious manner, but with the judicious kindness which should inspire a parent, or a guardian, or master.

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The habit should be met and combated by parent or master, not in the spirit of a severe judge towards a criminal offender, but in the manner of the man of the world knowing human nature, aware of its weaknesses, and seeking to minimise them by sagacious sympathy and confidence-winning explicitness.

Spermatorrhœa.—By this term is generally understood the uncontrollable escape, more or less frequently, of seminal fluid, at other times than, and not as the result of, the natural sexual excitement of coitus or the injurious sexual excitement of masturbation. It is very important for the medical man to bear in mind that as the result of continence, especially in young men, semen is pressed out of the vesiculæ seminales during defæcation, especially if the stools are hard and attended with much straining. The position of the vesiculæ seminales between the bladder and the lower part of the rectum, both of which organs are at the same time undergoing expulsive efforts, makes such a discharge from time to time of mechanical necessity and quite natural.

Again, nocturnal seminal emissions in men who observe continence and lead sedentary lives, and especially in young men, are quite natural and consistent with perfect sexual health, provided such emissions do not occur at shorter intervals than ten days to a fortnight. Again, let it be borne in mind that spermatozoa may be found in certain samples of a healthy man's urine as the result of the first flushing of the urethra after a coitus or an emission. And, lastly, the medical adviser should satisfy himself that the fluid that escapes from the urethra is really semen, and not mucus from the prostate, or muco-pus from a stricture or a gleet.

When nocturnal seminal emissions occur weekly, or twice or three times a week, or even oftener, they produce a relaxation of mental and physical tone. This is shown by inability for mental exertion or concentration of attention, flaccidity of will, hysteria, despondency, lassitude, aching back and lower limbs, dull pains in the groins, the feeling of something having given way across the loins, palpitation, cold clammy perspiration and a whole train of dyspeptic symptoms, with constipation of the bowels.

Such a debilitated state of the sexual apparatus may be induced by long or frequently-practised masturbation till seminal emissions occur on the slightest provocation, sometimes without any or only with the most imperfect erection, and with a minimum of pleasurable sensation.

Treatment.—The most important factor is the proper regulation of the daily life of the patient. A nutritious unstimulating diet, especially avoiding beer, wine, and spirits at night; a due amount of walking or other out-of-doors exercise, so as to produce a degree of physical fatigue by bedtime; going to bed in good time; early rising, and then at once plunging into a cold or nearly cold bath, or if this cannot be borne, sponging the genitals, perinæum, and lower part of the abdomen with cold water; well-directed mental

occupation, or travelling, or a sea voyage. These are the best remedies to prescribe.

If any local cause of irritation exists, it should be removed. An itching pile, a loaded rectum, intestinal worms, a long or tight foreskin, an engorged prostate, or an irritable bladder, may need attention.

The engorgement of the prostate is a thing of simple occurrence and easy remedy. It occurs in the early morning by the weight of the night's accumulated urine, and then erections and, with them, emission or temptation to masturbate, occur.

If the man who is the subject of too frequent nocturnal emissions, or who has practised masturbation, would empty his bladder immediately on waking, and at once get up and take his bath, he would go far towards curing his weakness.

The drugs that are of any use are strychnine, quinine, the mineral acids and bitter infusions, and arsenic. The preparations of iron are sometimes recommended, but they are apt, I think, to excite the sexual organs, and, though admirable as tonics, are not so beneficial in debility of the sexual organs as the other medicines I have named. Sedatives are not often needed, but, when required, hyoscyamus with camphor, or small doses of opium or morphia with camphor, had best be prescribed. The bowels should be kept in regular action, and any errors of digestion corrected by exercise and the proper selection and regulation of diet.

Impotence.—By this is meant the incapacity for coitus.

The causes of impotence are many and various. *Firstly*, congenital defects and deformities of the penis and testes such as extreme conditions of hypospadias and epispadias, or a persisting infantile condition of the genital organs. *Secondly*, impotence may be acquired in the course of several diseases. Thus it may arise from mere mechanical obstruction offered by the size of large scrotal herniæ, or hydroceles in which the body of the penis is buried in the protuberance of the tumour. The same result is also seen in some cases of elephantiasis of the scrotum and penis. Further, it occurs as a natural symptom and feature in certain acute and chronic diseases, such as diabetes and albuminuria, and in injuries of the brain and spinal cord, such as compression of the brain and fracture of the spinal column. *Thirdly*, impotence is brought about by the prolonged use of certain drugs, such as the bromides, iodides, opium, conium, camphor, arsenic, lead, and the abuse of alcoholic liquors. *Fourthly*, a few cases arise from psychical causes, perhaps due in part to some physical weakness, but to a larger extent to nervous anxiety on this very account on the part of the individual.

Treatment.—This must vary with the cause. In cases due to congenital defects and deformities the condition is often irremediable. When large scrotal herniæ or hydroceles are the cause, proper surgical treatment will soon set matters right. When impotence occurs as a natural sequela of disease, treatment must be directed to the disease of which it is only a symptom; and likewise when due to the abuse of drugs and alcohol, their use must be forbidden and

their effect combated. When fear, over-anxiety, despondency, or mistrust is the cause, it must be met by common-sense advice, by the employment of tonics, especially iron, sanmetto, strychnine, and quinine, and by encouraging patients to allow sexual matters to take their own course, and to avoid any forced efforts at intercourse.

Sterility.—By this term is meant the inability to procreate. It may or may not co-exist with impotence. A man may be sterile, yet sexually vigorous; he may be partially impotent, with feeble erection and rapid ejaculation, yet his semen may be fertile and be thus capable of impregnating the female; but if completely impotent, then is the man sterile also.

Sterility is caused (1) by the absence of spermatozoa in the seminal fluid—*azoospermia*; (2) by the absence of any seminal fluid—*aspermia*; (3) by failure of the ejected semen in reaching the vagina, owing to some malformation of the male organ.

(1) In the first form of male sterility there may be good natural power of erection and ejaculation, but the emitted fluid lacks that which alone can impregnate—viz. spermatozoa. This may proceed from deficient, defective, injured or diseased *testes*, and may be either permanent or temporary. When the testes are present and form spermatozoa, sterility may be due to obstruction in the *epididymis* or *vas deferens*, the result of a mass of unabsorbed inflammatory deposit, or of new growth in the globus major or minor, or of injury or rupture of the *vas deferens*. Syphilitic or tuberculous affections of the testis may check the formation of spermatozoa; the same affections of the epididymis or *vas* may obstruct the passage of the semen. Pus derived from any part of the generative tract, when present in the semen, may destroy the vitality of the spermatozoa.

(2) In the second form—*aspermia*—the power of copulation is present, but there is no emission. This may be due to some obstruction in the ejaculatory ducts, either from some congenital cause or from concretions of mucus, etc. In other cases there has been loss of sensibility about the glans penis, resulting either from spinal injury or due to indurated scar-tissue on the site of an old ulceration. Lastly, some spinal affection may interfere with the due performance of the reflex act, which is necessary for emission.

(3) In rare cases of epispadias and hypospadias the semen cannot be ejected into the vagina, though copulation is possible.

Treatment.—Many of the above-named causes being irremediable, nothing can be done in the way of treatment. When the cause is removable, as in stricture of the urethra, phimosis, or concretions in the prostatic portion of the ejaculatory ducts, the proper treatment for these conditions will remedy the sterility.

HYDROCELE.

Vaginal hydrocele.—This consists of an accumulation of fluid in the tunica vaginalis of the testicle. The effusion may be of an acute inflammatory nature, or may run a *chronic* course.

Acute vaginal hydrocele.—When, as the result of contusion, punctured wound, epididymitis, or orchitis, an effusion rapidly takes place into the tunica vaginalis; and when the same thing occurs during the course of erysipelas, rheumatism, or one of the continued fevers, acute vaginal hydrocele is said to exist. All such acute effusions are of an inflammatory character, the fluid being rich in cells of various kinds, and much more readily and spontaneously coagulable than ordinary hydrocele fluid. Such effusions may, if very plastic, become organised into permanent adhesions, or if the inflammation is very intense, or the patient in bad general health, suppuration may follow; but ordinarily, the fluid is rapidly and completely removed by absorption, under the same treatment which is employed for the promotion of absorption of inflammatory exudations in other parts of the body. It is not common, though it happens sometimes that an acute hydrocele passes into the chronic form. The acute hydrocele is always secondary to some injury or disease of the testicle or epididymis.

The *symptoms* are at first merged with those of the disease of the testicle upon which the inflammation of the vaginal membrane depends; and hence the fact that acute hydrocele is so frequently overlooked.

Treatment.—As the testicle or epididymis recovers, acute hydrocele nearly always disappears, and needs no special treatment apart from that required for the testis and epididymis. An acute hydrocele is usually of small size, and rarely needs tapping; but should the tunica vaginalis become markedly distended, the fluid should be withdrawn by the aspirator with due aseptic precautions. If signs of suppuration appear, free incisions into the vaginal sac should be made, and the cavity well irrigated and drained.

Chronic vaginal hydrocele.—There are two varieties of this affection. It may occur as secondary to some other disease of the testicle, such as syphilis, tubercle, or chronic inflammation, in which case the hydrocele is usually of small size; or it may exist as a primary idiopathic affection of the tunica vaginalis, in which case the hydrocele is frequently of large size. It is to the latter class that the term “chronic vaginal hydrocele” is usually applied, with which alone we have to deal now. The former class will be considered under the headings of the various diseases of the testicle in which secondary hydroceles are seen.

Causes.—The causes of primary vaginal hydrocele are very obscure, and little is known concerning them. In the great majority of cases the hydrocele commences insidiously and without any apparent cause. It is, as a rule, quite independent of any inflammation, and is a mere passive process due to the anatomical and mechanical conditions of the vessels and circulation of the cord and testicles. Various other predisposing and exciting causes have been alleged, such as heredity, chronic visceral disease, and residence in tropical climates. One other cause deserves mention, as it may

originate the hydrocele, and is a very pregnant cause of early re-accumulation of fluid after tapping. This is the presence of fibrous bodies that are met with either attached or free in the tunica vaginalis, but much more frequently attached. They are generally solid, but are sometimes cystic. They are very rarely cartilaginous, but occasionally become calcified.

When attached, they may be (1) irregularly scattered over the visceral portion of the tunica vaginalis, and are then of inflammatory origin; or (2) situated between the globus major and the testis proper. The latter form are the result of inflammatory changes in the vesicle or "hydatid" described by Morgagni, now known to be a relic of the duct of Müller. This vesicle may be quite converted into a small, fibrous, solid body, or, retaining its cystic character, may be converted into one of the forms of encysted hydrocele. The bodies are only met with in adult life, and chiefly in advanced age. They have been known to excite very severe suffering immediately after the fluid of a hydrocele has been withdrawn. When they are felt through the scrotum, and are a cause of hydrocele or of pain, they should be excised after laying open the tunica vaginalis.

Pathology.—The fluid, which in this form of hydrocele is contained in the sac of the serous covering of the testicle, is closely allied to ordinary serum. Its specific gravity is a fraction higher than healthy urine, 1022 to 1025; its reaction is neutral, and it contains about six per cent. of albumen, and a small amount of fibrinogen; thus it coagulates readily with any of the ordinary tests for albumen, but the fluid does not, as a rule, spontaneously coagulate. It is odourless and limpid and transparent, but varies in colour from a pale straw to a turbid green, unless mixed with blood, when it acquires a dull red or brownish colour.

Occasionally it is charged with cholesterin crystals, derived probably from the fatty degeneration and shedding of the cells lining the sac; the fluid is then glistening and less limpid. Alkaline carbonates and sodium chloride are contained in hydrocele fluid in marked amount. Under the microscope only a few epithelial and blood cells are to be seen.

The amount of the fluid contained in the sac varies greatly. From four to twelve ounces is common; but it may exceed a pint, and Cline withdrew six quarts from the hydrocele of the historian Gibbon.

If the hydrocele has been unirritated, the tunica vaginalis remains for long unchanged, except for more or less stretching; but in old, neglected, or injured hydroceles the tunica becomes opaque and thick, or cartilaginous, or calcified throughout or in patches, or it may acquire warty outgrowths on its surface.

Symptoms.—A pyriform swelling on one side of, and limited to the scrotum, with a smooth and uniform outline, elastic to the touch, translucent, giving no impulse on coughing, dull on percussion, and often giving a thrill on percussion, are symptoms which, when associated, are characteristic of common vaginal hydrocele. But

these characteristics may vary or be absent. Both *sides* of the *scrotum* are about equally often affected alone, and in about one *case* in every four or five both sides are affected together. The *shape*, instead of being pear-shaped, with the long axis obliquely upwards, may be round or oblong, and may have its longer axis *transverse*. *Translucency* may be wanting, either because of the *opacity* of the fluid from admixture of blood, or from the milky or *syrupy* or turbid nature of the fluid in some old hydroceles; or from the *opacity* and thickening of the tunica vaginalis and other tissues of the scrotum; or owing to adhesions within the vaginal sac, and to the multilocular character of the hydrocele. *Fluctuation* and *thrill* may be marked or may be absent altogether. When the sac is very tense or its walls are thickened, or its contents are not limpid, the thrill will not be obtainable at all.

The increase in size is slow and painless, but a dragging effect is experienced in the groin and loin. If the swelling increases along the cord, especially if it reaches upwards to the abdominal ring, an *elongated* process like the finger of a glove is produced. When there is a large hydrocele on both sides, the skin of the penis may be so dragged forwards that the glans penis is quite lost behind it.

Diagnosis.—Hydrocele is to be diagnosed from scrotal hernia, from hæmatocele, from solid tumours, and from other forms of hydrocele.

From hernia.—Hydrocele increases from below upwards, hernia from above downwards.

Hydrocele does not diminish or disappear of itself, hernia often diminishes or recedes entirely in the recumbent position.

Hydrocele is always dull, and may give a thrill on percussion; hernia never gives a thrill, unless the sac contains a large quantity of fluid, and is frequently in part or in whole resonant on percussion. When the hernia contains omentum and is entirely dull on percussion, it feels uneven and nodular—not uniform, like hydrocele.

Hydrocele gives no impulse on coughing, hernia does.

Hydrocele is translucent, hernia not (except very rarely in children).

In hydrocele the upper part of the cord can be felt, but the testicle is obscure. In hernia the upper part of the cord is obscure, but the testicle is readily made out.

Hydrocele, it must be remembered, is often complicated with hernia.

From hæmatocele.—Hydrocele is not usually preceded by violence, hæmatocele is caused by straining or an injury.

Hydrocele is elastic, hæmatocele solid and heavy.

Hydrocele is translucent, hæmatocele opaque.

The skin covering hydrocele is not discoloured, in hæmatocele it is generally ecchymosed, and if the extravasated blood be external to the tunica vaginalis the ecchymosis is intense and widespread, reaching sometimes into the inguinal and hypogastric regions.

From solid tumours.—The want of elasticity, uniformity, and

translucency, the rapid enlargement; pain; and, at any rate in the earlier stages of enlargement, the outline of the testicle and epididymis more or less changed, all point to a solid tumour of the testicle. In cancer the affection of the lymph glands, the solid infiltration along the cord; in tubercle and cancer the ulceration of the skin and formation of a fungus, and the impaired general health, are present in the more advanced stages.

From encysted hydrocele of the testis.—In the early stages encysted hydrocele is small and round; if the cysts are multiple, they may present a botryoidal outline. They may have existed for years before enlarging sufficiently to simulate vaginal hydrocele. In encysted hydrocele the testicle is commonly below and in front, or to the inner side of the cyst; it may be on the outer side, but is scarcely ever behind.

From encysted or diffuse hydrocele of the cord.—These forms of hydrocele start in the cord and increase downwards. They are confined to the region of the cord often for months or years before they encroach upon the tunica vaginalis testis, though they may at length invaginate the vaginal sac from above, and, increasing, occupy a large share of the scrotum.

From hydrocele of a hernial sac.—By the history of the case; but if this is unsatisfactory and the hernia is scrotal, it cannot be distinguished from an infantile hydrocele or a vaginal hydrocele with an inguinal process.

Treatment.—Spontaneous cures occur not rarely in children, but are not to be looked for in adults. In young children the fluid may be absorbed by stimulating or discutient lotions; in adults, hydrocele may disappear after an attack of inflammation of the testicle. Acupuncture has also succeeded in boys, but is not to be recommended. It is on account of its bulk, weight, or unsightliness—not because of pain or danger to life—that treatment is required. In children and boys and quite young adults damage may be done, however, to the testicle, owing to the dragging effects on the vas efferentia and epididymis, and to the atrophy of the testicle by thickening of its tunica albuginea and fibrous sclerosis of the gland tissue.

The palliative treatment consists in drawing off the fluid by tapping with a fine trochar and cannula. The position of the testicle should always be carefully made out in order not to wound it with the trochar, and in making the puncture any cutaneous vein should be avoided.

The radical or curative treatment.—The methods employed for the radical cure of hydrocele are (1) injections, (2) incision, (3) partial excision of the sac.

Injections.—This is a time-honoured treatment, and, on the whole, is very successful when properly performed, and when done for small and moderate-sized hydroceles in which the sac is not cartilaginous, calcified, or greatly thickened, and where no loose or pedunculated bodies are present within the sac.

Many drugs have been employed, but the most preferable are carbolic acid and the linimentum iodi diluted with twice its quantity of water. The sac should always be emptied before injecting, and the amount of the injection should vary with the size of the hydrocele. About half an ounce to an ounce of the iodine solution, and from half a drachm to a drachm of carbolic acid crystals, dissolved in 5 per cent. of glycerine, is a sufficient quantity.

The mode of cure is either by universal or partial adhesion of the parietal to the visceral portion of the tunica vaginalis, or by converting the serous membrane to a dull, dry, fibrous condition without power of secreting.

The untoward effects and accidents that may follow the injection of either iodine or carbolic acid are too much inflammation, cellulitis, sloughing, and suppuration in the sac, or abscess in the scrotum. Recurrence takes place occasionally after each method; indeed, hydrocele recurs after every known method of treatment. As a rare occurrence, carbolic acid poisoning has followed the use of this drug.

Antiseptic incision, or, better still, *excision* of the whole of that part of the tunica vaginalis which lines the scrotum, but without attempting to interfere with that covering the testis and epididymis, should be employed in preference to injection in the following cases:—(1) where the sac is very thick and opaque, cartilaginous, or calcified; (2) when there is doubt as to whether the hydrocele is of congenital nature, or is a hydrocele of a hernial sac, with a small opening into the peritoneum; (3) when hernia complicates hydrocele, and a radical cure of both is desired; (4) when a loose or pedunculated fibrous body is present in the tunica vaginalis; (5) when there is a doubt as to whether there is or is not serious organic disease of the testis; (6) when a vaginal hydrocele is associated with a hydrocele of the cord and an inguinal hernia.

Congenital hydrocele.—The process of peritoneum carried in front of the testicle in its descent into the scrotum, at first communicates with the general peritoneal cavity; but, normally, just before birth, or very shortly afterwards, that portion of the process that extends from the internal abdominal ring to the top of the testicle becomes obliterated. The obliterated portion is known as the funiculo-vaginal process of peritoneum. Sometimes, however, this obliteration does not take place, and fluid may accumulate in the funiculo-vaginal process and tunica vaginalis. Such an accumulation of fluid, communicating with the peritoneal cavity at the internal abdominal ring, is known as a congenital hydrocele of the testis. The size of the communication varies from that of a hay-straw, or less, upwards. Though generally met with in infancy and soon after birth, its occurrence may be delayed for a long time, even till adult life.

The fluid in some cases is derived from the peritoneum, and accumulates by trickling from above; in other cases it is secreted by the vaginal sac and process.

Congenital hydrocele is to be distinguished from congenital hernia by being dull on percussion; reducible gradually, and without jerk or thud, and only on steady, continuous pressure: by its translucency, and by not gurgling on manipulation. It has, however, an impulse on coughing and crying.

It is of some danger, because, if owing to any affection of testicle or epididymis, or to injury or other cause, inflammation or suppuration occurs in the sac, fatal peritonitis may be the result.

Treatment.—In children, stimulating and discutient lotions will sometimes effect a cure. If this does not succeed, the hydrocele should, if possible, be emptied into the abdomen and a truss worn, with a view of obliterating the funicular process. If this fails, the sac should be laid open, removed in part, and its neck ligatured.

The injection treatment is not to be recommended, on account of the communication with the peritoneal cavity; though it has been employed without harm after a truss has been worn for a short time previously.

Infantile hydrocele.—This form is not very uncommon; it differs from congenital hydrocele in that it is shut off from the peritoneal cavity by a partial obliteration of the funicular process, and generally as low down as the external abdominal ring. The fluid is, of course, derived from the vaginal sac itself.

It is also distinguished from the congenital hydrocele by the fact that it is quite irreducible, and does not lessen in size in the recumbent position or by elevating the scrotum. From hernia it is diagnosed by its translucency, its irreducibility, and absence of gurgling.

The only *treatment* required in most cases is acupuncture. If this fails, the incision and partial excision treatment will succeed.

Bilocular hydrocele or hydrocele "en bissac."—Two varieties of this condition are met with. (1) In one, from a variety of causes, the vaginal cavity may assume an hour-glass shape; or secondary pouches or diverticula on the front or sides of the tunica vaginalis may be present. A much rarer form of bilocular hydrocele is (2) where, in rare cases of infantile hydrocele, a diverticulum of the sac may extend into the abdominal or pelvic cavities. The abnormal process may be much larger than the funiculo-vaginal sac, and reach upwards between the muscles of the anterior abdominal wall and peritoneum, or extend downwards between the pelvic peritoneum and the wall of the false or true pelvis.

The best *treatment* is incision, followed by excision of as much of the sac as can be readily separated from its connections.

Inguinal hydrocele is the name given to common or vaginal hydrocele when the testis is undescended and occupies a position somewhere between the internal abdominal ring and the scrotum; or the testicle may have passed through the external ring and be situated between the aponeurosis of the external oblique muscle and the integuments. It presents itself as a tense fluctuating swelling, irreducible, and giving rise to the peculiar sickening

testicular sensation when tightly squeezed, and it has often a slight impulse on coughing. The corresponding side of the scrotum will be unoccupied. If the testicle is found, after tapping, to be small, the best treatment is excision of the testis with the sac; castration is also the treatment if the hydrocele recurs after simple tapping.

Encysted hydrocele of the testis and epididymis.—

Hydroceles of the epididymis and testis are entirely new formations. The fluid is contained in a cyst distinct from the tunica vaginalis and shut out behind that membrane like the testicle and epididymis themselves. They are often called **spermatoceles**, a term implying that the fluid contained within them is mixed with spermatozoa; and this is true of the great majority, though not of all. In some of the smaller cysts no spermatozoa are found. The fluid is thin, clear, limpid, and transparent, and non-albuminous or nearly non-albuminous. It is alkaline from the presence of alkaline carbonates that cause it to effervesce with acetic acid. As a rule, in the larger cysts the fluid is opalescent, milky, or like thin soap-and-water, owing to the large number of spermatozoa; and, no matter how often the cyst may be tapped, the re-collected fluid will contain these spermatozoa in abundance. Generally, the spermatozoa are lively and active, but in some instances they are quiescent, or even disintegrated, all traces of their tails being lost and only their heads remaining as small nucleus-like bodies.

Encysted hydrocele of the epididymis and testis might be appropriately described as cysts or new growths of the testicle.

Encysted hydrocele of the epididymis occurs either as *small cysts* varying in size from a pin's head to a pea, frequently multiple, and found usually in persons over forty years of age; and *large cysts*, usually single, varying in size, though rarely containing more than two or three ounces, and met with generally in men between twenty-five and fifty years of age. They make their first appearance usually before the forty-fifth year.

The small cysts are unimportant clinically unless they give rise to severe neuralgic pains, which is sometimes the case. They sometimes become detached and form the "*loose bodies*" occasionally found in the tunica vaginalis. They are very common in men of middle life and past. Cysts of the epididymis are situated outside the tunica vaginalis; but there are cases in which they have obliterated the tunica vaginalis and compressed the testicle. The large cysts do not as a rule contain more than a few ounces of fluid. Many different causes of origin have been assigned to cysts of the epididymis. The multiple small cysts met with in men of middle age are sometimes involution cysts due to changes in the epididymis, the result of advancing life.

The larger cysts are known as *spermatic cysts* (Fig. 917), and may be due to

- (a) Dilatation of a seminal tube, owing to some obstruction in the vas deferens or other part of the excretory passages; or
- (b) The rupture of a seminal tubule, with the escape of a few

drops of seminal fluid and the consequent formation of a cyst in the connective tissue between the tubes of the epididymis.

(c) The cyst may be formed originally in the connective tissue, and subsequently rupture into a seminal tubule.

(d) The cysts may arise from the distension of certain fetal relics that exist in the neighbourhood of the epididymis. These are:—(1) The paradidymis, or organ of Giraldes, which is situated in front of the vas deferens and above the head of the epididymis, and which is the remnant of the mesonephros or glandular portion of the Wolffian body.

(2) The ducts of Kobelt, situated in the globus major, which are remnants of the tubules of the Wolffian body.

(3) The hydatid of Morgagni, which is a vestige of the duct of Müller, and which lies as a tiny pediculated sac in front of the globus major.

(4) The vas aberrans of Haller, which is a blind convoluted diverticulum arising from the epididymis near the commencement of the vas deferens.



Fig. 917.—Spermatic Cyst.
(London Hospital Museum.)

Encysted hydrocele of the testis.

The cyst in these cases is situated between the tunica albuginea and the tunica vaginalis, or in the substance of the tunica albuginea itself. They are usually single, of small size, and so tense as to feel like solid bodies. They usually occur on the front of the body of the testis, and may attain to the size of a goose's egg or larger. They contain fluid, which has sometimes a greyish-brown colour. These cysts may arise as new formations in connective-tissue spaces, or possibly from a puncture of the testis in tapping for hydrocele.

Symptoms and diagnosis.—As stated above, the small multiple cysts are not usually of any clinical importance. The larger cysts grow slowly and insidiously, giving rise, as a rule, to no pain or sense of dragging. In their earlier stages they are rounded, and move with the testicle, above or on the outer side of which they are placed; as they grow they may become multilocular and lobulated, or pear-shaped with the large end upwards. They are usually translucent and elastic, if not fluctuating. The testicle is very rarely found behind the cyst; but is below and to the inner side, if not below and in front of the cyst. In doubtful cases the diagnosis will be made clear by tapping and examining the fluid withdrawn. It is rare for an encysted hydrocele to extend upwards along the groin, but when large and multiple it may do so.

Treatment.—So slight is the inconvenience which some encysted hydroceles produce that patients often decline having any treatment. A man under treatment for stricture, having a cyst as large as a

Tangerine orange, declined to have it tapped, because it caused no inconvenience.

When any treatment is employed, tapping with a fine trochar and cannula should be first tried, and will often suffice. If simple tapping fails, excision of the cyst is the best form of radical cure. These cysts are, as a rule, easily dissected out entire, and the result is quite satisfactory. If complete excision should not be found possible without damaging the testis, or epididymis, partial excision, with the application of pure carbolic acid, linimentum iodi, or silver nitrate to the portion left behind, should be employed.

The injection treatment is not very satisfactory, being even more apt to fail in encysted than in vaginal hydrocele.

Hydrocele of a hernial sac.—This term is applied when the sac of a hernia, emptied of its hernial contents and almost or quite shut off from the general peritoneal cavity, becomes distended with serous fluid exuded from its inner surface. Sometimes after the reduction of its contents the neck of the sac is obliterated by the pressure of a truss; or the orifice is completely occluded by a plug of adherent omentum; or, again, in a third class of cases, the sac still communicates with the peritoneal cavity by a very narrow channel. (*See* page 667.)

Symptoms and diagnosis.—There is usually the history of a hernia and of the wearing of a truss. There is a swelling in a common situation of a hernia, generally of an inguinal hernia. This swelling fluctuates or is elastic, and is frequently also translucent. It has little or no impulse on coughing, though it extends upwards with a sort of pedicle along the inguinal canal like a hernia. It obscures the cord, but is quite distinct from the testicle. It occurs rather later in life than encysted hydrocele of the cord, and is of larger size, and contains a darker and much more albuminous fluid than those hydroceles do. Encysted hydroceles of the cord appear usually about puberty, are small in size, and contain a light-coloured and but slightly albuminous fluid.

Treatment.—Injections should never be employed, because of the uncertainty as to whether or no there is a communication with the peritoneal cavity. Simple tapping may be tried, but if the fluid collects again, the complete removal of the sac should be the treatment. This is better and quicker than the aseptic incision, especially for cases in which there is a channel of communication with the abdominal cavity.

HÆMATOCELE.

Hæmatocele is a collection of blood in the tunica vaginalis or in the scrotal tissues outside the tunica vaginalis.

Cause.—It is nearly always traumatic in origin, and follows suddenly the reception of a blow, kick, or puncture of the testis or tunica vaginalis, as in tapping common hydrocele. It may also follow tapping a hydrocele from the giving way of some weakened vein or capillaries as soon as the hydrostatic support derived from

the hydrocele is taken away. Hæmatocele is also sometimes seen in association with malignant disease of the testicle. Finally, a hydrocele by a blow or contusion may be converted into a hydro-hæmatocele.

Pathological changes vary with the age of the hæmatocele. In old cases the *sac* is greatly thickened, partly by layers of false membrane of fibrinous characters, or connective tissue, and partly by sclerosis of its own structure. Both the false membranes and the sclerosed sac may be in places cartilaginous or calcareous. The connective tissue outside the sac is often thickened, and the testis altered in shape, atrophied, or absolutely unrecognisable.

The contents in old hæmatocele are chiefly solid, and consist either of dirty-coloured clot, laminated as in an aneurysm, or of soft clot devoid of lamination; the fluid blood, if any is present, will be thick, dark, and treacly. In more recent cases fatty matter and cholesterin will be found; the sac is much less changed, and the false membranes, if any are present, are but feebly adherent: the contents are a mixture of fluid blood of a deep red colour mixed with dark blood-clot, some of which will be adherent to the walls.

Symptoms.—These are characterised by the rapid formation of a scrotal tumour after an injury or tapping a hydrocele, or if a hydrocele already exists, it rapidly increases in size and tenseness. The swelling in either form of the affection has the shape and outline of hydrocele, but is not translucent, feels heavier and firmer, and is often associated with ecchymosis of the scrotum and even of the skin of the groin and upper part of the thighs. If it comes on after tapping, free external bleeding may occur through the punctured wound. The testicle occupies the same position as in hydrocele, namely, behind and on a vertical level somewhat below the centre: it can be made out on manipulation in recent cases by the peculiar testicular sensation.

The surface of the swelling is not invariably uniformly smooth and regular; for it may be yielding in some spots, very resisting in others, and bossy or lumpy, or of cartilaginous hardness in others—this especially may be the case in old hæmatoceles.

It should be borne in mind by the student that occasionally the onset of hæmatocele may be insidious, and its progress slow or irregular.

If inflammation ensues, the swelling will become hot and tender and painful. There will be increased temperature, and if the case goes on to suppuration rigors may occur, whilst the tumour will bulge and soften at some point with much throbbing pain.

Diagnosis.—Hæmatocele has to be distinguished from hydrocele, solid enlargements of the testicle, and from hernia.

From *hydrocele* by its opacity, greater firmness, want of fluctuation, and its suddenness of onset. In a recent hæmatocele there may be discoloration of skin. An aspirating needle would settle any doubt that existed.

From *enlarged testicle* by the history, rate of increase, the

discovery of the testicle of natural size and sensibility at the back of the swelling, by less pain and tenderness than in orchitis and new growths, and by the swelling having a less definite outline of the testicle than exists in either orchitis or the early stage of new growths. In many cases, however, it will only be by an exploratory incision that the distinction can be made.

From *hernia* by the absence of impulse, the better definition of the spermatic cord, and by the swelling commencing in the scrotum—not at the inguinal canal. It is between large hæmatoceles of long standing and irreducible scrotal omental hernia that there will be most difficulty in diagnosis; but in most of such cases of hernia there has been a time in their course when they were reducible.

Treatment will be either palliative or curative. *Palliative treatment* is applicable in the early stages of hæmatocele, and consists in absolute rest in the recumbent position, with the scrotum well raised on a cushion or in a sling; the constant application of an ice-bag in the robust and of evaporating lotions in the very old or feeble; and by the occasional use of aperients to keep up a regular and free action of the bowels. If little or no progress in absorption is made, some of the fluid blood should be withdrawn through a cannula, and the same treatment as above described continued. A second or a third tapping may be advisable. When the blood has been well-nigh removed, and if there is no pain or marked tenderness, strapping may be applied with advantage.

Radical cure.—In hydro-hæmatocele, when the tunica vaginalis is not much thickened, the injection treatment is advised by many, but is not to be recommended, because in many cases the tunica vaginalis will have been ruptured, and thus the injection fluid will probably find its way into, and cause inflammation of, the extra-vaginal scrotal tissues; and further, because there are masses of blood-clot in the fluid which may undergo degenerative changes if the injection fluid excites much inflammation of the tunica vaginalis. The best treatment is a free incision into the sac, and after turning out the contents, the tunica vaginalis and any adherent false membrane should as far as possible be removed, except over the testicle and epididymis. The part of the sac left should be rubbed with carbolic acid, iodine, or nitrate of silver. If suppuration occurs in a hæmatocele, free incision, and drainage after turning out the clots, should be early performed.

Castration should be unhesitatingly performed when the testicle is degenerated by fibrous or fatty changes, as is often the case in old-standing hæmatoceles; when the tunica vaginalis is much diseased; when the patient is old and feeble; when the hæmatocele has ruptured, and blood is diffused amongst the tissues of the scrotum; or when suppuration or sloughing is threatened. It shortens convalescence, and diminishes the risk of hæmorrhage, of cellulitis, and of blood-poisoning.

Encysted hæmatocele.—A hydro-hæmatocele is sometimes

formed by an extravasation of blood into an encysted hydrocele. Such cases are rare. The causes, symptoms, and treatment call for no special remarks, being similar to those of hæmatocele of the tunica vaginalis.

Hæmatoma of testis and epididymis.—It occasionally happens that extravasation of blood takes place into the substance of the testicle or of the epididymis as the result of a blow or other injury inflicted upon the organ.

It probably sometimes follows the accidental puncture of the testicle in tapping a hydrocele. In some cases hæmatocele of the tunica vaginalis, as well as hæmatoma of the testis, has been caused by the same injury.

Symptoms.—Intense throbbing pain, following quickly upon an injury, with a feeling of great fulness and tension of the testis or epididymis, entirely unrelieved by elevation or treatment, would give rise to the suspicion of hæmatoma. The testis or epididymis, as the case may be, will be larger than normal; probably it will be very tender at one spot, but not acutely so all over, as in acute epididymo-orchitis.

Treatment.—When palliative measures have been tried and have failed, a small puncture or incision into the tender spot will sometimes give immediate relief. If the testicle is much disorganised, castration should be performed.

EPIDIDYMITIS AND ORCHITIS.

When inflammation affects the body of the testicle alone, we speak of it as orchitis; when it involves the epididymis alone, we speak of it as epididymitis; and when it involves both body of testicle and epididymis, it is called epididymo-orchitis.

It is very uncommon for inflammation that begins as epididymitis to spread to the body of the testicle.

Epididymitis may be acute, subacute, or chronic.

Acute epididymitis. Causes.—Acute or subacute epididymitis is almost always excited by some affection of the membranous or prostatic urethra, such as gonorrhœa, or gouty or other form of urethritis; the use of instruments upon the urethra; stricture of the urethra, and the changes that take place behind a stricture; by inflammatory conditions of the prostate, prostatic calculi, ulceration of the prostatic urethra; impacted calculus in the urethra; contraction of the meatus; and possibly by the frequent voiding of urine highly charged with uric acid, and by the use of very strong urethral injections. Injury is but a rare cause of this disease.

Various theories have been advanced to explain the frequency of epididymitis in connection with urethritis, prostatitis, and other forms of urethral irritation. Some of these must be mentioned.

(1) *Metastasis*, or the shifting of inflammation from one part to the other, as in rheumatic fever. (2) *Sympathy*. (3) *Reflex congestion*, brought about in this instance in the same way as duodenal

congestion and ulceration are said to be excited by huge superficial burns. (4) *Direct extension* of the inflammation from the urethra along the vas deferens to the epididymis. It is possible that each of these theories is on occasions justified, but in the large majority of cases facts seem to prove that the theory of "direct and continuous extension" is the correct one. A strong argument in favour of the latter theory is afforded by those cases in which the vas is affected by inflammation whilst the epididymis escapes.

Pathology.—The globus minor is the part chiefly affected. The thickening of the globus minor is due to exudation into the cellular tissue between convolutions of the duct and that immediately beneath the tunica vaginalis. The tubes of the epididymis are in places dilated into little pouches filled with pus. The tunica vaginalis is always somewhat inflamed.

Symptoms.—Aching, then more acute pain, and then swelling of the epididymis, are the leading symptoms. The globus minor is the seat of the first marked swelling, but an early and careful examination in many cases of the cord will detect some tenderness or even thickening there; and some patients refer to a pain in the inguinal or deep pelvic regions.

The swelling increases in the tail of the epididymis and spreads upwards in the body to the globus major, and thus a boat-shaped enlargement and hardness can be detected on the outer and back part of the testicle, if the sickening pain and exquisite tenderness will permit of a careful digital examination. Later this condition may be lost, owing to the effusion of fluid into the vaginal sac and the matting together of the inflamed tissues with the lower part of the testicle. In the very acute cases the amount of fluid poured out by the tunica vaginalis is considerable, and the condition sometimes described as "*acute hydrocele*" is produced.

The scrotum is more or less red, glossy, and œdematous, and in many cases the cord is painful and swollen up to the external ring.

Rigors may usher in or occur during the early part of the attack, the temperature for several days is usually above normal, a feeling of sickness or vomiting may be present, the bowels are generally constipated, the tongue is foul, and the patient thirsty.

In an acute case the symptoms increase for four or five days and remain at their height for two or three days more, from which time they rapidly decrease, and the patient is convalescent in from a fortnight to three weeks. Some amount of hardness and thickening of the cellular tissue of the globus minor may remain for months or even become permanently organised.

When epididymitis occurs in the course of gleet or urethritis, the urethral discharge will generally cease or diminish during the acuteness of the inflammatory attack, and return again when it is over. Though both epididymes may be affected, they are attacked one after the other, never simultaneously.

Prognosis.—With few exceptions, acute epididymitis terminates in resolution. A small hard thickening of the globus minor may

Orchitis and epididymo-orchitis.—There is this difference between primary orchitis and primary epididymitis, that whereas it is rare for the inflammation to reach the testicle proper when the epididymitis has been caused, as it is most usually, by some prostatic or urethral irritation or disease, it is quite common for inflammation of the testes, from whatever cause arising, to extend to the epididymis.

Causes.—Orchitis may occur alone, as the result of *injury*, of cold, of congestion from unfulfilled function, or of some constitutional or bacterial condition. It may be acute, subacute, or chronic. The chronic forms are generally, though not always, either the sequel of the acute or subacute, or else are of syphilitic origin.

Orchitis occurs in *gout*, and less frequently in *rheumatism*, and is met with as a complication of many infectious diseases—viz. *mumps*, *typhoid fever*, *small pox*, *scarlet fever*, *influenza*, *malaria*, and *tonsillitis*. The inflammation of the testicle behaves somewhat differently, according to its cause.

Symptoms.—When due to *mumps*, the testicle alone is commonly affected, the epididymis rarely. It begins about the sixth or eighth day of the illness, attacks boys and young adults, and is unknown in childhood and old age. The course of the orchitis is rapid, the testicle attaining twice its size in a day or two; it is attended by fever, more or less pain, and tenderness. The pain, sometimes slight, is in other cases very severe, and radiates along the groin to the hypogastrium and loins. The constitutional disturbance at the outset of the attack may be severe, even alarming; intense fever, delirium, epistaxis, and diarrhœa or collapse may usher in the orchitis, but they generally disappear when the orchitis is established. The testis preserves its smooth and natural outline, and is less hard than in some other forms of orchitis. One testicle after the other may be involved, but it is rare for both to be affected simultaneously. After the fourth day the local inflammation begins to subside, and the disease usually ends in resolution. Atrophy of the testicle is reported by foreign surgeons to have occurred in some epidemics, and that, too, even in mild cases.

When due to *typhoid fever*, the epididymis is rarely—some observers say never—affected, unless the inflammation is set up by the irritation of catheterism, and then the epididymis only may be attacked. One testicle only is affected. The onset is commonly sudden, but may be gradual; it occurs during the height of the fever or during convalescence therefrom. The pain is not so great as in other forms of orchitis; or, possibly, less attention is drawn to it during the delirium of the fever. The inflammation is not generally severe; the attack lasts from six to ten days, or it may be even much more transient; it usually ends in resolution, but suppuration, atrophy, or persistent induration may follow, though very rarely. Cases of inflammation of the body of the testicle have been reported as occurring in the course of *small pox*, *scarlet fever*, and *influenza*.

Orchitis occurring in persons subject to *malarial fever* follows or

testicle, or in the second stage of tuberculosis, or in the tertiary stages of syphilitic orchitis; or after sloughing from injury, fever, extravasation of urine, and other causes; or in the progress of malignant disease.

Pathology.—In malignant disease—sarcoma or carcinoma—the protruding mass (*fungus hæmatodes*) is new growth, not testicular tissue. In the tuberculous and the syphilitic forms the protrusion may consist of glandular tissue and granulation material, or of granulation and inflammatory material only. The fungus may spring from the scrotum, tunica vaginalis, tunica albuginea, or from the tubular structure of the testicle or epididymis.

The *tuberculous fungus* is generally situated on the outer side of the testicle, and in connection either with the epididymis or testis proper, and usually springs from the cavity of a tuberculous abscess.

The *syphilitic fungus* begins in the breaking-down of a gumma of the body of the testis; or of a thickened, gummatous condition of the tunica albuginea; or, very exceptionally, in a gumma of the scrotum.

Treatment.—The superficial form sometimes disappears under local and constitutional treatment—viz. iodoform dusted over the fungus, and tonics, good diet, and cod-liver oil in the tuberculous variety; red oxide of mercury powder locally, and mercury and iodide of potassium internally, in the syphilitic form. Strapping may be applied with advantage in some cases. In other cases the herniated tissues should be excised, together with the edges of the opening in the scrotum. These tissues are then completely detached from their adhesions around the peduncle of the fungus; the peduncle is scraped clean away and dusted with iodoform; pressure with iodoform gauze is maintained for a few minutes, and then the scrotal tissues are united by sutures over the testicle. In severe and obstinate cases of tuberculous fungus castration is the only remedy, and should not be long deferred.

SYPHILIS AND TUBERCULOSIS OF THE TESTICLE.

The testicle is affected with syphilis both of acquired and congenital origin. Syphilis of the testicle, as commonly met with, occurs in the intermediate and tertiary stages of the disease, and in two forms—(1) as diffuse or interstitial orchitis, (2) as gummata. Both these forms are spoken of as syphilitic sarcocele.

Syphilitic epididymitis.—Syphilis affects the epididymis, though rarely, in the early secondary stage, and then occurs as a localised nodular mass, the size of a pea, in the *globus major*. It is painless, slow in progress, and the enlargement is never great nor is the testicle proper generally involved. The disease rapidly yields under mercury, and, like other forms of secondary syphilis, tends to spontaneous cure if not treated.

Congenital syphilitic disease of the testicle.—This is seen in the form of a chronic orchitis or sarcocele.

advances the fluid is absorbed, and tough fibrous adhesions form between the surfaces of the tunica vaginalis, until at length complete obliteration of the vaginal cavity is the result. The epididymis and cord are usually unaffected. The scrotal tissues may become adherent to some part of the testicle as a necessary forerunner of hernia testis. In very exceptional cases the spermatic cord has been thickened and even nodulated. When the vas deferens is thickened search should be made for any urethral irritation which may have acted as an exciting cause of the orchitis.

Symptoms.—The testicle slowly and insidiously enlarges until perhaps it reaches the size of a pear or an orange. It is either pyriform or rounded in shape, smooth, or irregular, or nodular on the surface, painless, heavy, and resistant to the touch, and generally quite devoid of the ordinary testicular sense. The scrotum is unaffected except when hernia testis is threatened. There is often slight hydrocele.

One testicle only may be affected, or both may be so either consecutively or simultaneously; the second testis may be attacked whilst the patient is under specific treatment for the first. If the disease is not treated, and is thus allowed to take its course, the function of the testicle is impaired or lost. When an injury has immediately preceded and excited the attack the onset may be quite sudden and painful, and the symptoms may resemble those of acute epididymo-orchitis. These acute symptoms, however, last only a few days.

Diagnosis.—Syphilitic orchitis has to be distinguished from chronic orchitis, tubercular disease, new growths of the testicle, and, when it is excited by an injury, from the acute inflammatory affections of the testicle. From all these diseases the history of the case, the physical characters of the enlargement, the frequency of bilateral affection, the co-existence of other evidences of syphilis, and the undoubted improvement under mercurial treatment when continued for a few weeks, will suffice to prove the specific nature of the orchitis.

Prognosis.—Syphilitic orchitis, especially when treated early, usually ends in resolution. Impotence and sterility only result from advanced disease in both organs. Atrophy, the breaking down of gummata, and hernia testis are occasional terminations. Syphilitic disease of the testicle never ends in suppuration.

Treatment.—This should be both local and constitutional. The local consists in removing any hydrocele fluid by tapping, and then strapping the testicle with simple soap or mercurial plaster. The constitutional treatment should be the avoidance of alcohol, the discontinuance of sexual connection, and the administration of mercury alone, or mercury combined with small doses of iodide of potassium.

Tuberculous disease of the testicle.—Chronic tuberculous disease of the testicle may be either (a) primary, or (b) secondary to tuberculous deposits in some other part or organ of the genito-urinary apparatus, or (c) the testicle may be affected with acute tuberculosis as part of a general disease, but this is very rare.

Pathology.—In the earliest clinical stages of tuberculous testis a small nodule is present in the head of the epididymis, followed in time by similar nodules in other parts of the epididymis. By degrees these nodules may coalesce until the whole epididymis is converted into an irregular, hard, boat-shaped mass (Fig. 919). At a later stage the tuberculous mass softens and breaks down in one or more places, and, after ulcerating through the tissues of the scrotum, a fistulous opening or a hernia testis may result.

The explanation given of the frequency with which the epididymis is the first part affected by the bacilli is the small size and the great tortuosity of the blood-vessels of the epididymis as compared with those of the testicle and vas deferens, and the fact that the spermatic artery divides opposite the epididymis into two main branches: one for the epididymis and the other for the testicle proper.

The tunica vaginalis is the seat of chronic inflammation, and by the formation of adhesions between the visceral and parietal portions the cavity becomes partially or entirely obliterated. The vas deferens is frequently thickened and indurated, its walls being infiltrated and its cavity stuffed with the products of the tuberculous inflammation. This thickening may be regular and continuous for an inch or two, or irregular nodules may be dotted along the cord.

The parts of the vas deferens generally affected are its two extremities, so that frequently, when it feels to be normal, at the upper part of the scrotum and in the groin, one or other or both its extremities may be much diseased.

In association with disease at the prostatic end of the vas deferens are similar changes in the vesiculæ seminales and prostate, and these organs ought always to be examined with the finger in the rectum before expressing an opinion as to the limitation of the disease or the advisability of castration.

Causes.—The essential cause is the entrance of the tubercle bacillus into the system of an individual whose testicular structures are susceptible to its pathogenic action. The predisposing causes are hereditary taint, injury, venereal excitement, and gonorrhœa.

It is possible that in a few cases the tubercle bacillus may be inoculated at the same time as the microbe of gonorrhœa.

Symptoms.—The course of the disease has been artificially divided into *three stages*. The first may be called the stage of deposit; the second, the stage of caseation; and the third, the stage of fistulæ or of fungus testis.

The *first stage* of primary tuberculosis of the testis is almost certainly unnoticed by the patient, because the onset and progress of the disease are painless. When detected in this stage by the surgeon it presents itself as a nodule, or as nodules, in the epididymis, and generally in the upper part of the epididymis. These nodules are at first hard and well defined, and devoid of any symptom of inflammation. By degrees the whole of the epididymis may be involved, either uniformly or as a string of nodules. As a rule, the nodules are larger in the head and tail than elsewhere.

The testicle itself usually remains unaltered for a time, then softens, and becomes more diffuent than elastic, and small, round, shot-like bodies may be felt near the hilum. In rare cases the body of the testis, as well as the epididymis, may be affected simultaneously, and, enlarging, form a swelling the size of a hen's egg, or larger, in which there is no distinction between epididymis and testis proper. There may be some hydrocele fluid in the general sac of the tunica vaginalis or in a cyst-like space of the sac.

In the *second stage* the tubercle nodules soften into a caseous mass in a slow, insidious, and painless manner. Over one of these softening nodules the tunica vaginalis and, later, the skin become adherent; the skin becomes red, then bluish, and, later, still darker in colour, and fluctuation is detected. The period at which this second stage sets in varies, in different cases, from several weeks to some years. It is generally not till after several months.

The *third stage* is marked by the ulceration of the skin over the adherent and discoloured parts and the discharge of a puriform fluid with curdy or cheesy flakes. Later, fistulous openings are established, and a fungus testis as above described may form. Not infrequently both testicles are affected either simultaneously or within a short time of one another.

The **diagnosis** is rarely a matter of any difficulty. The small hard nodules which are sometimes left behind after an attack of *acute epididymitis* are distinguished by being in the globus minor rather than in the globus major, in following an acute inflammation of the organ, in having no tendency to suppurate, break down, or become adherent to the scrotum, and in not being associated with signs of tuberculous affection of the prostate, vas deferens, or vesiculæ seminales.

The disease with which tuberculous testis is most likely to be confounded is *tertiary syphilis* of the testicle, this mistake being possible when the epididymis and the body of the testicle are alike involved in the tuberculous process. But in such a case the tendency of tubercle to soften and break down, its irregular nodular outline, its tendency to become worse, not better, under the anti-syphilitic treatment, and the result of inoculation experiments with the discharge from the fistulæ or fungus, or even with the fluid of an accompanying hydrocele, will serve to clear up any doubt. In all other cases the differential diagnosis between syphilitic and tuberculous disease of the testis can, by due attention to the signs and symptoms already enumerated, be made without any difficulty.



Fig. 919.—Tuberculous Disease of the Testicle. (London Hospital Museum.)

persist for a long time. Abscess and sloughing occasionally occur in the unhealthy and debilitated, and in very rare cases a local or general peritonitis has been set up.

Treatment.—The patient should remain in bed, have the scrotum well raised, and for the first three or four days keep an ice-bag or an iced evaporating lotion constantly applied. A full dose of calomel should be given at once if the bowels are constipated, and a saline mixture composed of nitrate of potash, spirits of nitric ether, and carbonate and sulphate of magnesia should be taken every eight hours. If the patient is healthy or plethoric it will be well to add twenty drops of antimonial wine to each dose of the medicine; and if there is acute pain, and there nearly always is, eight or ten minims of tincture of opium should be also added. The diet should be light, and consist only of milk, beef-tea, and light puddings. An extra dose of morphia or opium may be required at night. Of late years anemone pulsatilla has been highly recommended by several excellent authorities; two or three drops of the extract of pulsatilla every four hours are said rapidly to subdue swelling, heat, and pain. After the acuteness of the inflammation has subsided a mixture containing potassium iodide and bicarbonate will assist the absorption of the inflammatory products, and the testicle should still be kept well elevated. At the end of a fortnight, if all pain and tenderness have vanished, the testicle should be strapped and the patient allowed up, still, however, keeping the scrotum suspended in a well-fitting suspensory bandage.

In the early stage, if ice cannot well be borne, or if, owing to the age or feebleness of the patient, sloughing is anticipated, warm fomentations of lead and opium, lead and carbolic acid, or of poppy heads, should be applied and changed every two or three hours.

In very robust men, and where the inflammation runs high, leeches or venesection of one of the superficial veins of the same side of the scrotum is beneficial; the bleeding following either method can be checked by collodion and cotton-wool.

Chronic epididymitis.—The two most common varieties of chronic epididymitis are the tuberculous and the syphilitic. These will be described under their respective headings. Chronic inflammation may also occur as a sequel of the acute or subacute form of inflammation, and is then nearly always due to some mischief persisting in the deep urethra.

Owing to the immediate proximity of the orifices of the ejaculatory ducts, there is, so long as the urethra is not in a healthy state, a great tendency for inflammation to extend to one vas deferens and epididymis as soon as it has subsided in the other, and then after a time to recur in the first as soon as the second has nearly recovered. In this way may be formed those small fibrous masses in the tail of the epididymis, which, persisting, may result in sterility. Knowing this, the surgeon should insist upon continuance of treatment until the urethral trouble is cured and the deposits in the epididymis are absorbed.

Orchitis and epididymo-orchitis.—There is this difference between primary orchitis and primary epididymitis, that whereas it is rare for the inflammation to reach the testicle proper when the epididymitis has been caused, as it is most usually, by some prostatic or urethral irritation or disease, it is quite common for inflammation of the testes, from whatever cause arising, to extend to the epididymis.

Causes.—Orchitis may occur alone, as the result of *injury*, of cold, of congestion from unfulfilled function, or of some constitutional or bacterial condition. It may be acute, subacute, or chronic. The chronic forms are generally, though not always, either the sequel of the acute or subacute, or else are of syphilitic origin.

Orchitis occurs in *gout*, and less frequently in *rheumatism*, and is met with as a complication of many infectious diseases—viz. *mumps*, *typhoid fever*, *small pox*, *scarlet fever*, *influenza*, *malaria*, and *tonsillitis*. The inflammation of the testicle behaves somewhat differently, according to its cause.

Symptoms.—When due to *mumps*, the testicle alone is commonly affected, the epididymis rarely. It begins about the sixth or eighth day of the illness, attacks boys and young adults, and is unknown in childhood and old age. The course of the orchitis is rapid, the testicle attaining twice its size in a day or two; it is attended by fever, more or less pain, and tenderness. The pain, sometimes slight, is in other cases very severe, and radiates along the groin to the hypogastrium and loins. The constitutional disturbance at the outset of the attack may be severe, even alarming; intense fever, delirium, epistaxis, and diarrhoea or collapse may usher in the orchitis, but they generally disappear when the orchitis is established. The testis preserves its smooth and natural outline, and is less hard than in some other forms of orchitis. One testicle after the other may be involved, but it is rare for both to be affected simultaneously. After the fourth day the local inflammation begins to subside, and the disease usually ends in resolution. Atrophy of the testicle is reported by foreign surgeons to have occurred in some epidemics, and that, too, even in mild cases.

When due to *typhoid fever*, the epididymis is rarely—some observers say never—affected, unless the inflammation is set up by the irritation of catheterism, and then the epididymis only may be attacked. One testicle only is affected. The onset is commonly sudden, but may be gradual; it occurs during the height of the fever or during convalescence therefrom. The pain is not so great as in other forms of orchitis; or, possibly, less attention is drawn to it during the delirium of the fever. The inflammation is not generally severe; the attack lasts from six to ten days, or it may be even much more transient; it usually ends in resolution, but suppuration, atrophy, or persistent induration may follow, though very rarely. Cases of inflammation of the body of the testicle have been reported as occurring in the course of *small pox*, *scarlet fever*, and *influenza*.

Orchitis occurring in persons subject to *malarial fever* follows or

accompanies the fever, but generally at a late period of the disease, and yields readily to quinine. It comes suddenly, lasts two or three days, during which the testicle may swell to three or four times its natural size, the testicle and epididymis being completely blended in the hard, smooth mass. The scrotal veins swell, the skin is œdematous, and there is generally a little fluid poured out into the tunica vaginalis. Pain is severe, and may be paroxysmal; it passes off when the temperature falls. The swelling may take three or four weeks to disappear, and the testicle may be left atrophied, or the epididymis enlarged and hard.

Gouty orchitis commonly affects persons over fifty who are subjects of bronchitis, laryngitis, dyspepsia, or arthritic pains of gouty nature. It occurs more rarely in men of typically gouty constitution, or during or just before an acute attack of gout. The inflammation is acute, and may, though rarely, spread to the epididymis; there is a good deal of pain and swelling, the body of the testicle being uniformly smooth and hard. It is often a very obstinate affection, and may end in suppuration. Even when the inflammation is chronic from the outset, it may end in suppuration. Gouty orchitis often affects both testicles, one after the other, so closely that both organs are involved simultaneously. It is frequently brought on by fatigue or over-exercise.

Treatment.—The treatment of acute and subacute orchitis, if of traumatic origin, is the same as for epididymitis. Some modifications are required, according to the cause of the orchitis, when occurring in the course of other diseases, or as the outcome of some constitutional condition. In orchitis due to mumps, or typhoid fever and the other infectious diseases, warm boracic or lead and opium lotion should be applied to the scrotum instead of ice; or the combined ointments of opium, conium, and belladonna should be spread over it beneath fomentations. A dose of Dover's powder or morphia should be given at night, and the scrotum should be kept well raised from the first and throughout the attack, the patient being confined to bed the while. Gentle laxative medicine will be required at the beginning of, and during the orchitis, but no lowering aperients or other measures are suitable. A saline mixture, followed in a day or two by one of quinine, or acid and bark, or ammonia and bark, and a nutritious diet are the other adjuncts of treatment required.

In orchitis with ague quinine should be given. In orchitis from gout or rheumatism the general treatment is that appropriate to gout or rheumatism itself; the local application should be ice in the robust, but warm sedative lotions in the old or feeble.

Fungus or hernia testis.—This term is applied to the protrusion of the testicular substance through the tunica albuginea and skin of the scrotum. The size of the protrusion varies from a pea to the whole substance of the testis, but as a rule it is not much larger than a cherry or a strawberry.

Causes.—It may occur either as the result of an abscess of the

testicle, or in the second stage of tuberculosis, or in the tertiary stages of syphilitic orchitis; or after sloughing from injury, fever, extravasation of urine, and other causes; or in the progress of malignant disease.

Pathology.—In malignant disease—sarcoma or carcinoma—the protruding mass (fungus hæmatodes) is new growth, not testicular tissue. In the tuberculous and the syphilitic forms the protrusion may consist of glandular tissue and granulation material, or of granulation and inflammatory material only. The fungus may spring from the scrotum, tunica vaginalis, tunica albuginea, or from the tubular structure of the testicle or epididymis.

The *tuberculous fungus* is generally situated on the outer side of the testicle, and in connection either with the epididymis or testis proper, and usually springs from the cavity of a tuberculous abscess.

The *syphilitic fungus* begins in the breaking-down of a gumma of the body of the testis; or of a thickened, gummatous condition of the tunica albuginea; or, very exceptionally, in a gumma of the scrotum.

Treatment.—The superficial form sometimes disappears under local and constitutional treatment—viz. iodoform dusted over the fungus, and tonics, good diet, and cod-liver oil in the tuberculous variety; red oxide of mercury powder locally, and mercury and iodide of potassium internally, in the syphilitic form. Strapping may be applied with advantage in some cases. In other cases the herniated tissues should be excised, together with the edges of the opening in the scrotum. These tissues are then completely detached from their adhesions around the peduncle of the fungus; the peduncle is scraped clean away and dusted with iodoform; pressure with iodoform gauze is maintained for a few minutes, and then the scrotal tissues are united by sutures over the testicle. In severe and obstinate cases of tuberculous fungus castration is the only remedy, and should not be long deferred.

SYPHILIS AND TUBERCULOSIS OF THE TESTICLE.

The testicle is affected with syphilis both of acquired and congenital origin. Syphilis of the testicle, as commonly met with, occurs in the intermediate and tertiary stages of the disease, and in two forms—(1) as diffuse or interstitial orchitis, (2) as gummata. Both these forms are spoken of as syphilitic sarcocele.

Syphilitic epididymitis.—Syphilis affects the epididymis, though rarely, in the early secondary stage, and then occurs as a localised nodular mass, the size of a pea, in the globus major. It is painless, slow in progress, and the enlargement is never great nor is the testicle proper generally involved. The disease rapidly yields under mercury, and, like other forms of secondary syphilis, tends to spontaneous cure if not treated.

Congenital syphilitic disease of the testicle.—This is seen in the form of a chronic orchitis or sarcocele.

Congenital sarcocele, in its pathology, is usually of the interstitial form; gummata are rare; but there is not infrequently a combination of the interstitial and gummatous forms. The epididymis may be, but is not often, involved. Both testicles are often simultaneously attacked. The organ is as hard as scirrhus, may be nodular, is not painful or tender, and may become the seat of hernia testis. The enlargement is not great, and may be, especially in the earlier stages, masked by hydrocele. Atrophy of the organ is prone to follow.

Syphilitic sarcocele of the adult.—This is an affection of the late secondary and of the tertiary stages of syphilis. It occurs in the two forms mentioned above, but in many instances they are combined.

Pathology.—(1) *The interstitial orchitis* is a chronic inflammation of the intertubular connective tissue affecting more or less of the organ, but generally leaving some areas of it free. When the inflammation proceeds unchecked the cellular products, which are grouped in irregular mass or diffused in lines along the intertubular septa, are converted into fibrous tissue, and this, in turn, is followed by contraction, resulting in scarring, puckering, and, finally, atrophy of the organ. The walls of the vessels and tubules and the tunica albuginea participate in the same changes as the intertubular connective tissue. If atrophy ensues, it is generally a slow and gradual process, although cases have been witnessed in which the testis has shrivelled to the size of a haricot bean in the space of only a few months.



Fig. 918.—Syphilitic Disease of the Testicle. (London Hosp. Mus.)

(2) *The gummatous orchitis.*—This is probably only a legacy of a previous diffuse inflammation, or it may be a localised inflammation started in the coats of a spermatic vessel or tubule. The nodules that occur in this form of orchitis are at first minute, but, blending together, may at length form masses or gummata the size of marbles or much larger (Fig. 918). The gummata are usually multiple.

There is a great tendency for them to caseate and break down, and in this respect, as well as in general structure and character, they resemble gummata in other textures and organs of the body. An uneven surface is often given to the testicle, partly owing to the puckering and thickening of the tunica albuginea, and partly to the nodular swellings of superficially-placed gummata. The diffuse form of orchitis is often largely combined with the gummatous, the former being an earlier stage of the gummatous form.

Associated with both these forms of orchitis there is generally much irregular thickening of the tunica albuginea; and in the earlier stages there is a small degree of hydrocele, but as the disease

advances the fluid is absorbed, and tough fibrous adhesions form between the surfaces of the tunica vaginalis, until at length complete obliteration of the vaginal cavity is the result. The epididymis and cord are usually unaffected. The scrotal tissues may become adherent to some part of the testicle as a necessary forerunner of hernia testis. In very exceptional cases the spermatic cord has been thickened and even nodulated. When the vas deferens is thickened search should be made for any urethral irritation which may have acted as an exciting cause of the orchitis.

Symptoms.—The testicle slowly and insidiously enlarges until perhaps it reaches the size of a pear or an orange. It is either pyriform or rounded in shape, smooth, or irregular, or nodular on the surface, painless, heavy, and resistant to the touch, and generally quite devoid of the ordinary testicular sense. The scrotum is unaffected except when hernia testis is threatened. There is often slight hydrocele.

One testicle only may be affected, or both may be so either consecutively or simultaneously; the second testis may be attacked whilst the patient is under specific treatment for the first. If the disease is not treated, and is thus allowed to take its course, the function of the testicle is impaired or lost. When an injury has immediately preceded and excited the attack the onset may be quite sudden and painful, and the symptoms may resemble those of acute epididymo-orchitis. These acute symptoms, however, last only a few days.

Diagnosis.—Syphilitic orchitis has to be distinguished from chronic orchitis, tubercular disease, new growths of the testicle, and, when it is excited by an injury, from the acute inflammatory affections of the testicle. From all these diseases the history of the case, the physical characters of the enlargement, the frequency of bilateral affection, the co-existence of other evidences of syphilis, and the undoubted improvement under mercurial treatment when continued for a few weeks, will suffice to prove the specific nature of the orchitis.

Prognosis.—Syphilitic orchitis, especially when treated early, usually ends in resolution. Impotence and sterility only result from advanced disease in both organs. Atrophy, the breaking down of gummata, and hernia testis are occasional terminations. Syphilitic disease of the testicle never ends in suppuration.

Treatment.—This should be both local and constitutional. The local consists in removing any hydrocele fluid by tapping, and then strapping the testicle with simple soap or mercurial plaster. The constitutional treatment should be the avoidance of alcohol, the discontinuance of sexual connection, and the administration of mercury alone, or mercury combined with small doses of iodide of potassium.

Tuberculous disease of the testicle.—Chronic tuberculous disease of the testicle may be either (a) primary, or (b) secondary to tuberculous deposits in some other part or organ of the genito-urinary apparatus, or (c) the testicle may be affected with acute tuberculosis as part of a general disease, but this is very rare.

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Tuberculous disease of the testicle.—Chronic tuberculous disease of the testicle may be either (a) primary, or (b) secondary to tuberculous deposits in some other part or organ of the genito-urinary apparatus, or (c) the testicle may be affected with acute tuberculosis as part of a general disease, but this is very rare.

Pathology.—In the earliest clinical stages of tuberculous testis a small nodule is present in the head of the epididymis, followed in time by similar nodules in other parts of the epididymis. By degrees these nodules may coalesce until the whole epididymis is converted into an irregular, hard, boat-shaped mass (Fig. 919). At a later stage the tuberculous mass softens and breaks down in one or more places, and, after ulcerating through the tissues of the scrotum, a fistulous opening or a hernia testis may result.

The explanation given of the frequency with which the epididymis is the first part affected by the bacilli is the small size and the great tortuosity of the blood-vessels of the epididymis as compared with those of the testicle and vas deferens, and the fact that the spermatic artery divides opposite the epididymis into two main branches: one for the epididymis and the other for the testicle proper.

The tunica vaginalis is the seat of chronic inflammation, and by the formation of adhesions between the visceral and parietal portions the cavity becomes partially or entirely obliterated. The vas deferens is frequently thickened and indurated, its walls being infiltrated and its cavity stuffed with the products of the tuberculous inflammation. This thickening may be regular and continuous for an inch or two, or irregular nodules may be dotted along the cord.

The parts of the vas deferens generally affected are its two extremities, so that frequently, when it feels to be normal, at the upper part of the scrotum and in the groin, one or other or both its extremities may be much diseased.

In association with disease at the prostatic end of the vas deferens are similar changes in the vesiculæ seminales and prostate, and these organs ought always to be examined with the finger in the rectum before expressing an opinion as to the limitation of the disease or the advisability of castration.

Causes.—The essential cause is the entrance of the tubercle bacillus into the system of an individual whose testicular structures are susceptible to its pathogenic action. The predisposing causes are hereditary taint, injury, venereal excitement, and gonorrhœa.

It is possible that in a few cases the tubercle bacillus may be inoculated at the same time as the microbe of gonorrhœa.

Symptoms.—The course of the disease has been artificially divided into *three stages*. The first may be called the stage of deposit; the second, the stage of caseation; and the third, the stage of fistulæ or of fungus testis.

The *first stage* of primary tuberculosis of the testis is almost certainly unnoticed by the patient, because the onset and progress of the disease are painless. When detected in this stage by the surgeon it presents itself as a nodule, or as nodules, in the epididymis, and generally in the upper part of the epididymis. These nodules are at first hard and well defined, and devoid of any symptom of inflammation. By degrees the whole of the epididymis may be involved, either uniformly or as a string of nodules. As a rule, the nodules are larger in the head and tail than elsewhere.

It usually remains unaltered for a time, then softens, becomes more diffident than elastic, and small, round, shot-like, and may be felt near the hilum. In rare cases the body of the testis, as well as the epididymis, may be affected simultaneously, forming a swelling the size of a hen's egg, or larger, in which there is no distinction between epididymis and testis proper. There may be some hydrocele fluid in the general sac of the tunica vaginalis or in a cyst-like space of the sac.

Second stage the tubercle nodules soften into a caseous manner. Over one of the softening nodules the tunica vaginalis and, later, the skin becomes adherent; the skin becomes red, then bluish, and, later, changes in colour, and fluctuation is detected. The period of this second stage sets in and varies, in different cases, from several weeks to months. It is generally not till after several months.

Third stage is marked by the cracking of the skin over the adherent and discoloured parts and the discharge of a purulent fluid with curdy or cheesy contents. Later, fistulous openings are formed, and a fungus testis as above may form. Not infrequently the scrotum and adjacent parts are affected either simultaneously or within a short time of one another.



Fig. 919.—Tuberculous Disease of the Testicle. (London Hospital Museum.)

Diagnosis is rarely a matter of difficulty. The small hard nodules sometimes left behind after an acute epididymitis are distinguished by being in the globus minor rather than in the globus major, in following an acute inflammation of the organ, in having no tendency to suppurate, break down, and form a fungus testis, and in not being associated with tuberculous affection of the prostate, vas deferens, or seminal vesicles.

Prognosis in cases with which tuberculous testis is most likely to be mistaken is *tertiary syphilis* of the testicle, this mistake being often made when the epididymis and the body of the testicle are involved in the tuberculous process. But in such a case the tendency of tubercle to soften and break down, its irregular outline, its tendency to become worse, not better, under syphilitic treatment, and the result of inoculation experiments, the discharge from the fistulæ or fungus, or even with the absence of an accompanying hydrocele, will serve to clear up any doubt. In all other cases the differential diagnosis between syphilitic and tuberculous disease of the testis can, by due attention to the symptoms already enumerated, be made without any difficulty.

Treatment consists in the removal of the tuberculous testis, which is most likely to be mistaken for *tertiary syphilis* of the testicle, this mistake being often made when the epididymis and the body of the testicle are involved in the tuberculous process. But in such a case the tendency of tubercle to soften and break down, its irregular outline, its tendency to become worse, not better, under syphilitic treatment, and the result of inoculation experiments, the discharge from the fistulæ or fungus, or even with the absence of an accompanying hydrocele, will serve to clear up any doubt. In all other cases the differential diagnosis between syphilitic and tuberculous disease of the testis can, by due attention to the symptoms already enumerated, be made without any difficulty.

Sarcoma and other *malignant growths* generally will be distinguished by their affecting the body of the testicle, first and chiefly by their greater weight and painfulness, by their more rapid growth, and by being confined to one organ, whilst tubercle is prone to attack both testicles. Examination per rectum will not discover any enlargement of the prostate or vesiculæ.

Prognosis.—The rate of progress of the disease varies much in different cases. It may remain long localised to the epididymis, or rapidly extend to the testicle proper, or after a prolonged period of quiescence in one stage it may suddenly start into fresh activity. In every case, however, it tends sooner or later to a fatal termination, either by extension to the urinary part of the genito-urinary apparatus, or by setting up secondary tuberculous disease in some other tissues or organs. By early recognition the disease, when primary, may be in some cases checked by change of residence to a suitable climate; in others it may be eradicated by well-timed surgical treatment.

Treatment.—This will be either medical and palliative, or operative. The medical treatment consists in good air, good diet, cod-liver oil, tonics, stimulants in the shape of a moderate quantity of good port wine, and, in fact, everything which will improve the health and hygienic condition of the patient. In the early stages of the disease a residence in some warm dry climate, or at the seaside, or sea-voyages have proved in many cases to be very beneficial. But if improvement does not soon follow upon general, hygienic, and climatic treatment, some surgical operation will be requisite, and should be undertaken without further loss of time. This consists either in removing the deposits, or in scraping out the fistulæ, or in castration.

Medical treatment should be tried as long as the deposits are small and hard; but as soon as caseation has commenced, operative treatment should be employed.

Erasure of all the softened areas and thorough rubbing of the cavities with iodoform have in many cases been sufficient to check the disease, and should always be tried first when the deposits are small and few and there is no extension of the disease along the genito-urinary apparatus or secondary deposits of tubercle elsewhere. When erasure has failed, when the fistulæ persist or are numerous, when there is fungus with a small wasted testis, and when the whole or greater part of the organ is invaded, castration is the only treatment.

Castration may be done for two different classes of case—first, as a curative operation for advanced cases where the disease is limited to one testicle and has not extended too high along the cord, and when the bladder, prostate, and vesiculæ seminales are unaffected, and where, therefore, the whole disease can be removed; and, secondly, as a means of prolonging life and giving relief in cases where direct extension of the disease or secondary deposits elsewhere preclude the possibility of cure. It is, however, only in

cases in which the testicle is painful or discharging that operation as a palliative measure should be adopted. As a rule, medical and hygienic treatment only should be resorted to in such cases.

NEW GROWTHS OF THE TESTICLE.

Solid growths.—The varieties of solid tumours of the testicle which have been described are (1) carcinoma, (2) sarcoma, (3) lymphadenoma, (4) chondroma, (5) fibroma, (6) myxoma, (7) myoma, and (8) osteoma.

(1) **Carcinoma** occurs in the *medullary* form; scirrhus is well-nigh unknown—no well-authenticated case being on record. The medullary cancer of the testis is very soft, being composed of a very delicate and highly vascular fibrous tissue, the alveoli of which are filled with cells like those of the seminal epithelium. The new growth starts in the glandular epithelium of the tubules in the centre of the organ near the rete testis. It at first is confined within the tunica albuginea, and so long as this is so, the testicle, though much and rapidly enlarged, is ovoid in shape and regular in outline; but as the disease progresses nodular projections form on the surface, and at length the tunica albuginea gives way, the skin becomes involved, and a fungus hæmatodes results.

On section the tumour is creamy-white, pinky-white, or fawn-coloured, very soft, and its cellular substance is readily washed away by a gentle stream of water, leaving a flocculent filamentous membrane behind. Extravasations of blood commonly occur into the substance of the tumour, and other changes are apt to occur in it, such as colloid, caseous, and mucoid, fatty, and cystic degenerations.

The epididymis is usually lost in the mass. The structures of the cord become infiltrated by the growth; and the pelvic and lumbar glands are invaded by propagation along the course of the lymphatics. By extension from these glands the spinal column and spinal cord, or the mesentery, peritoneum, abdominal viscera, and lungs, may become involved.

(2) **Sarcoma** occurs as a soft, round-celled medullary tumour, with very little intercellular substance; or as a firm, fleshy tumour composed of spindle and mixed cells, and having an abundant fibrillar stroma—the fibro-sarcoma. When the matrix is more mucous and elastic, or granular, than fibrous, the growth is called myxo- or granulo-sarcoma. The round-celled or medullary sarcoma is the one most often met with in the testicle in an unmixed form. The fibro-sarcoma, myxo-sarcoma, and granulo-sarcoma are often combined with other tissues of the connective-tissue type, such as cartilage, muscle, or fat. Conversely, a myxoma or chondroma may after a time become sarcomatous by conversion of connective-tissue elements into spindle or round cells.

The sarcomata are usually described as originating in the connective tissue between the tubules, or in that contained in the

wall of the tubules. In naked-eye appearances, in rapidity and mode of growth, and in the mode of extension of the disease to the lymphatic glands and other organs, the sarcomata resemble the carcinomata. Sarcoma is more apt to attack both testicles, and to be associated with multiple secondary deposits in the skin, than is carcinoma.

Myo-sarcomata and lympho-sarcomata occur as rare growths in boys and young men. They grow rapidly and terminate fatally by secondary growths in distant organs.

The **clinical history of carcinoma and sarcoma** shows that their exciting cause is frequently some form of injury. They mostly occur between twenty-five and forty-five, carcinoma being almost unknown in infancy and boyhood, though sarcoma is met with in childhood as well as in young adult and middle life. Both forms of disease develop rapidly and often painlessly, and as long as the tunica albuginea remains intact the tumour, though of great size, retains the normal shape of the testicle; thus, unfortunately, mistakes in diagnosis are frequent, the disease being regarded as inflammatory, and castration delayed till too late to be of much benefit. In other cases the consistence of the swelling is so soft that the new growth is apt to be mistaken for hydrocele or hæmatocele. In other cases, if seen in an early stage, the testicle feels firmer at the part in which the disease is commencing. A small hydrocele is present in some cases.

Severe pain is, as a rule, absent, but a feeling of weight and dragging is complained of. The cord enlarges at first from turgescence of its blood-vessels, subsequently from infiltration of its tissues with new growth. Later the lumbar glands enlarge, the skin becomes adherent at one part, a fungus hæmatodes results, and the patient dies worn out by exhaustion, from discharges and hæmorrhages, from secondary growths and the general malnutrition of malignant disease.

Diagnosis.—Carcinoma and the soft varieties of sarcoma are not distinguishable except by the microscope. As a rule, carcinoma more quickly invades the cord and scrotum than does sarcoma. Carcinoma does not occur in infancy and childhood; sarcoma may. There is a risk that some of the forms of orchitis may be mistaken for one of the firmer and more slowly-growing sarcomata; but the history of syphilis in some cases, the antecedent symptoms of inflammation in others, the chronic indolent nature and uniformly hard character of the swelling in other forms of orchitis, will assist towards a correct diagnosis.

Hæmatocele will be distinguished by the sudden formation of the swelling following an injury; and old hydroceles by their history, duration, and the use of the aspiratory needle.

Prognosis and treatment.—The only prospect of cure or prolongation of life lies in early castration. It is, unhappily, the common case for recurrence to take place in the lumbar and pelvic glands within a year, more or less, after castration; but there are

on record some most encouraging instances of patients living several years after the operation without any return of the disease.

Other solid growths.—The other forms of solid new growths enumerated above are very rare and of little clinical importance. The several structures of which they are composed are seldom met with *alone* in tumours of the testicle; but in combination with one another, with cysts, or with cancer and sarcoma, they are not uncommon. Castration is the only treatment.

Cystic tumours of the testicle.—Under this heading are included the “Cystic fibromata,” or simple cystomata, and the “Cystic sarcomata.” The former are benign, the latter malignant; but between these two typical forms there are all grades of intermediate varieties.

In the **cystic fibromata** the cysts are the leading prominent feature, and the intercystic stroma is composed of simple fibrous or fibrillar tissue (Fig. 920). The contents of the cysts vary, being sometimes clear and limpid, at others thick and glairy, sometimes colourless or clear yellow, at others opaque, white, curdy, or brownish, like coffee-grounds. In the **cystic sarcomata** the cysts are much smaller, fewer in number, and less uniformly distributed, and contain papillomatous, sessile, or pedunculated masses, whilst the intercystic stroma is more mixed, and consists of myxomatous, round- and spindle-celled sarcomatous, fibro-myxo-sarcomatous or myomatous tissues. In both forms, but especially in the cystic fibromata, a certain amount of cartilage may be found; in both, the testicular tissue is found in a large number of cases expanded over the growth; in both, the disease starts in the neighbourhood of the mediastinum testis, and in both recurrences after removal, and metastatic deposits are not infrequent.



Fig. 920.—Cystic Tumour of the Testicle.
(London Hospital Museum.)

Symptoms and course.—They may affect the testicle at any age between birth and old age. They grow insidiously and painlessly. The more innocent forms may attain slowly, even through a period of many years, to the size of a turkey's egg or larger. They are smooth, uniform, and ovoid; but, as they enlarge, careful palpation may detect some spots softer and more elastic than others. The spermatic cord and lymphatic glands are unaffected; the general health is not impaired. They rarely affect children or old men, but are mostly met with in the middle period of life. I have, however, met with fibro-cystic disease in a boy under ten years of age.

The more malignant grow much more rapidly, and may attain to

a much greater size in the course of a comparatively few months. They feel more elastic to the touch, and as they grow they tend to become uneven on their surface and to throw out bosses or nodules (still covered by the tunica albuginea) into the cavity of the tunica vaginalis.

Prognosis is grave in the cystic sarcomata and uncertain in the cystic fibromata, as recurrences or metastatic deposits may take place in any form of these tumours.

Treatment.—Castration is the only remedy, and ought not long to be delayed, especially if the tumour is growing rapidly.

Teratomata.—In connection with cystic disease mention must be made of teratomata. These are (1) congenital cystic growths containing fragments of bone, teeth, nervous tissue, or intestine; or (2) the more ordinary forms of dermoid cysts containing epithelium, hair, or sebaceous material. Both kinds are met with outside the testicle, near the junction of the testicle and epididymis. Their mode of origin is uncertain. They are always congenital, and are in some cases noticed immediately after birth, but in others they have not been detected for many months. They may remain quiescent, or may become inflamed and suppurate and burst.

Prognosis.—They tend to cause atrophy of the testicular structure, and may possibly develop into malignant disease.

Treatment.—They should be operated upon early; either they should be incised freely, and their contents evacuated with scoop, forceps, and sharp spoon, and then drained; or castration should be performed.

INJURIES AND DISEASES OF THE SPERMATIC CORD.

Contusions of the cord.—What is described as *diffused hæmatocele* and hæmatoma of the cord is an extravasation into the meshes of the cellular tissue. It arises from falls astride, direct blows, strains by suddenly and violently abducting the lower limb, falls from a horse, violent coughing, etc. It is much more likely to occur in young adults the subjects of varicocele than in others, but it has happened in boys of only eight years of age.

The extravasated blood may either be widely diffused in the cellular tissue, or be collected within a limited space so as to form an elongated, cylindrical, or sausage-shaped swelling; or the two conditions may exist together.

Treatment consists of rest in the recumbent position and the application of ice or cold lotions. If the swelling tends to increase, or if absorption does not take place satisfactorily, the swelling should be laid open, the blood-clot turned out, any bleeding vessel ligatured, and the wound antisepticated and closed by sutures. A drainage-tube had best be retained for twenty-four or thirty-six hours.

Rupture of the vas deferens.—This is a rare accident, and is not generally referred to in surgical works. It is most likely to occur at that part of the vas which is between the internal abdominal

ring and the ureter, and is caused by a violent blow on the lower part of the abdomen, by the passage of a cart wheel, or by a sudden strain, as in slipping or falling with the legs wide apart.

The symptoms at first much resemble a contusion or slight rupture of the urethra. There is slight urethral bleeding derived from the torn artery of the vas, but no hæmaturia. There will be violent pain in the region of the groin. Micturition will be probably painful, though voluntary micturition will remain. Further, the catheter will probably pass easily. There will be no extravasation of urine, and, later, the absence of thickening about the urethra and the atrophy of the testis will clear up the case.

Treatment.—This is purely palliative. Rest, with the application of cold lotions or ice bag to the groin, is all that can be done. If inflammation or suppuration follows, it must be treated on ordinary surgical lines. Atrophy of the testicle follows rupture of the vas.

Inflammatory affections of the cord.—It is rare for any of the structures of the spermatic cord to be the seat of inflammation.

The vas deferens, with the cellular tissue around it, may become acutely inflamed owing to the extension of inflammation spreading along it from the urethra. Gonorrhœa, an urethral stricture, or an operation in the urethra may be the starting-point; or an acute phlebitis of the spermatic veins, whether varicose or not, may set up an inflammation of the other structures of the cord. The cellular tissue of the cord may be inflamed without the participation of the vas deferens. Lastly, inflammation starting in the skin and subcutaneous tissue may extend to the tissues of the cord; and if the funiculo-vaginal process of peritoneum is patent, a fatal general peritonitis may ensue.

Treatment.—Acute inflammation of the cord should be treated as acute inflammations elsewhere. Pus should be evacuated by early and deep incisions, as matter in some cases is very deeply placed.

Hydrocele of the cord.—Hydrocele of the cord is an accumulation of serous fluid, either within a distinct cyst or diffused amongst the cellular tissues of the spermatic cord.

There are four varieties, only one of which is at all common, and that is (1) the encysted variety. The other three are (2) the hydrocele of the unobliterated funicular process of the peritoneum, (3) a rare form of hydrocele along (though not of) the cord, namely, hydrocele of a hernial sac, and (4) the diffused hydrocele of the cord.

1. **Encysted hydrocele of the cord.**—In this form the fluid is contained in one or more distinct cavities or cysts, which are formed (*a*) by the imperfect or irregular obliteration of the funicular process of peritoneum. These are much more common on the right side than on the left, owing to the fact that the closure of the funiculo-vaginal process takes place earlier and more completely on the left side. The cysts may be single or multiple. They vary in size from a pea to a hazel-nut or larger, and may be situated within the inguinal canal, or at any spot between the external abdominal ring and the testis. They are often associated with congenital

hernia. Being of congenital origin, they are often seen in childhood; but, on the other hand, young adult, middle, or advanced age may be reached before the cysts become distended with fluid.

(b) Much less frequently encysted hydrocele may result from the formation and distension of a cyst space in the cellular tissue of the cord quite independently of any want of proper obliteration of the funiculo-vaginal process of peritoneum.

2. Hydrocele of the unobliterated funicular process.—

There are two varieties. In one the funicular process, though shut off from the cavity of the tunica vaginalis at the top of the scrotum, is patent elsewhere, and communicates by a variable-sized orifice with the general peritoneal cavity. This variety is known as "congenital hydrocele" of the cord. In the second variety the funicular process is closed both at the internal ring and at the scrotum, but is patent between these points. This variety is known as infantile hydrocele of the cord.



Fig. 921.—Encysted Hydrocele of the Cord. (London Hospital Museum.)

Symptoms, diagnosis.—The swelling varies in shape and size, according to its mode of origin. It is round (Fig. 921) or oval or oblong in form, defined in outline, uniformly smooth on the surface, painless, often translucent, and moves freely with the cord if it be of either of the first two varieties. By pulling upon the testis the swelling is made to descend; by pressing the swelling upwards it will partly or entirely disappear within the inguinal canal, but it cannot be reduced completely beyond the abdominal walls, and it occasions no gurgling sound as it recedes. The testicle rises as the hydrocele is pushed up. Fluctuation is by no means

distinct; percussion generally, but not always, gives a dull note; and when the swelling is entirely below the external ring there is no impulse whatever on coughing. Translucency cannot be made out if the patient is very fat, or if the swelling is confined between the external and internal rings.

Treatment.—In very young children discutient lotions, such as the chloride of ammonium, spirit or lead lotions, or counter-irritants, such as tincture or ointment of iodine, may disperse the swelling. Acupuncture has also succeeded in the very young. Injections are to be avoided in the second variety, as they might reach the peritoneal cavity. The best treatment is the radical cure, namely, the excision of the cyst or cysts in the encysted variety, and the removal of the funicular process in the second variety. In cases where the fluid is reducible into the abdomen, the wearing of a well-fitting truss may effect a cure.

3. Hydrocele of a hernial sac.—This condition has already been described under “Hydrocele of the Testis,” and need not be further referred to here.

4. Diffuse or infiltrated hydrocele of the cord.—This is a very rare condition of œdema of the cellular tissue which contains the spermatic vessels. Pott and Scarpa are almost the only surgeons who have reported well-authenticated cases. It is not a hydrocele but an œdema, and ought to be so called.

Symptoms.—It causes little or no trouble; the scrotum, testis, and epididymis are unaffected; the spermatic cord is increased in size, has a pyramidal form with its broader part below; it recedes gradually on pressure, but swells again on ceasing pressure. If the swelling extends along the inguinal canal, it dilates the abdominal rings and produces to the touch and to the eye a semblance of omental hernia. The size attained may be great; in one case Pott drew off eleven Winchester pints of fluid.

Treatment.—This is only necessary when it is large and causes deformity, or is inconvenient because of its weight. It must then be radically cured by an aseptic incision and packing or drainage.

Hæmatocele of the cord.—Hæmatocele of the cord may be either diffuse or encysted, but, unlike hydrocele of the cord, the diffuse is less rare than the encysted.

Diffuse hæmatocele of the cord is brought about by rupture of one of the blood-vessels of the cord, usually one of the spermatic veins, whether varicocele exists or not, followed by the more or less rapid extravasation of blood into the cellular tissue of the cord. A blow, kick, or hard straining at stool may be the cause of the rupture.

Symptoms and diagnosis.—An oblong or rounded swelling appears over the site of the cord immediately after some violence. The swelling may occupy the whole or any part of the funicular pouch, and may more or less conceal the testis. It is smooth in outline, solid in consistency, and there may or may not be ecchymosis. It may be mistaken for an omental hernia, but the mode of onset, the irreducibility and want of impulse, will distinguish hæmatocele.

Treatment.—If rest, with ice or evaporating lotions and absorbent ointments and well-adjusted pressure, fail to produce absorption, or if the tension from the first is great, an incision should be made, clots and fluid blood turned out, and the cavity well rubbed with iodoform and drained. Castration may be needed, and in elderly men is certainly the best treatment.

Encysted hæmatocele.—Either of the forms of encysted hydrocele may be transformed into hæmatocele. This transformation may occur spontaneously, or as the result of wound of the cyst wall. It needs no special description.

Treatment.—Complete excision, if possible. If part of its wall is very adherent to the vas, and cannot be removed, the part left behind should be well rubbed with crude carbolic acid or some other irritant.

Solid tumours of the cord.—Except the lipomata, of which many have been recorded, solid new growths of the spermatic cord are very rare. After the lipomata, sarcomata are the next most frequent. Examples of myxoma, myxo-sarcoma, myxo-lipoma, fibroma, and myoma, or fibro-myoma arising in the muscular and fibrous tissue of the vas deferens, have each been published. Carcinoma of the cord has never, to my knowledge, been recorded, except as an extension of or as secondary to carcinoma of the testis.

Lipomata as a rule originate in the subperitoneal fat, and are little by little protruded through the abdominal rings; occasionally they are developed from fatty lobules contained within the coverings of the spermatic cord.

Symptoms and diagnosis.—Lipomata form painless elongated swellings, sometimes soft, almost to fluctuating, like fatty tumours in other parts of the body; they are distinct from the testicle, not reducible within the abdomen; and give little or no impulse on coughing; though in some exceptional cases they have appeared suddenly, they generally increase slowly and by degrees; pulling upon the testis causes them to descend, which is not the case with an omental hernia. They are situated within all the coverings of the cord, but are external to a peritoneal pouch, if any such exists.

The other solid tumours of the cord call for no special description here. They exhibit the same characteristics as are presented by them elsewhere.

Treatment.—As lipomata generally tend to increase in size and become a source of real inconvenience, though not of pain; and as, when of subperitoneal origin, they predispose to hernia; and finally, as in time they contract firm adhesions to cord, testis, and peritoneum, it is best to remove them at an early period. Most of these reasons apply even with much greater force to the other forms of solid tumours, and they should likewise be removed freely and at the earliest possible date. Castration in the case of malignant tumours may be needed, as the growth will have almost certainly extended upwards from the testicle.

Varicocele.—Varicocele is the name given to the varicose conditions of the veins in the spermatic cord. Some of these veins surround the vas deferens and accompany the artery of the vas, others and the larger sets are situated more in front of the vas, and frequently surround the spermatic artery. The latter veins form the pampiniform plexus, and are generally involved in varicocele.

Varicocele is an affection of puberty and young manhood. In more than half the cases the affection begins between the fifteenth and twenty-fifth years; 80 per cent. are first noticed before the thirty-fifth year. The varicosity frequently disappears after middle life, and is very rarely seen in old men. The left side is affected from twenty-five to thirty times oftener than the right, and in about 7 per cent. of cases both sides are affected.

Pathology.—The veins of the pampiniform plexus are dilated, elongated, and tortuous, and their walls are in parts thickened,

and in some places thinner than normal (Fig. 922). The changes in the veins are chiefly due to inflammatory processes of a low type. Phlebitis and thrombosis occasionally arise as complications, whilst of still rarer occurrence is suppuration or the rupture of one of the varicose veins. The varicose state is most marked from just above the testicle upwards to the level of the symphysis pubis; it rarely affects the veins in the inguinal canal, and still more rarely the trunk of the spermatic vein upon the psoas muscle.

Causes.—Many theories have been advanced which lack of space forbids us to dwell on here. It is probable that varicocele, occurring as it does most frequently at or soon after puberty, is brought about through the rapid developmental changes in the sexual apparatus acting upon veins which are predisposed to varicosity (1) by their great tortuosity; (2) by their great length and dependent position; (3) by their want of support from the loose tissue which surrounds them; (4) by the constant pressure to which they are subjected by the contraction of the abdominal muscles, and (5) by the very feeble *vis a tergo* force with which the blood circulates through them owing to the great length and small calibre of the spermatic artery.

That varicocele retrogrades spontaneously as manhood advances, and is very rarely seen in old men, are facts which oppose the theory that it is induced by the direct connection of the spermatic veins with the portal system through the colico-spermatic branches; it is precisely at those periods of life when varicocele is so rare that engorgement and congestion of the portal circulation are prone to occur.

Various reasons have been assigned, but with too little proof, for the greater frequency of left varicocele. The pressure of the fecal-laden sigmoid flexure upon the spermatic vein, the great length of the left vein, its entrance into the left renal vein at a right angle to its own course, and the greater force and frequency of the contraction of the muscles of the left half of the abdomen in right-handed persons, have each been described as the cause of the greater frequency of varicocele of the left side. The theory of the congenital origin of varicocele is supported by the fact that a section of the cord in the fetus at birth shows that the united lumina of the veins on the left side are very greatly in excess of the corresponding sections on the right side.

Symptoms.—The testicle is usually normal, though, if the veins which surround it are affected, it may be masked by them; the scrotum is more or less relaxed, and may or may not be marked by varicose veins on its surface. When the patient stands, the veins swell to a more or less considerable size, and feel like a congeries of soft, distended, but easily compressed tubes, or, as it is described in books, "like a bag of worms" (Fig. 922). They are often visible through the thin scrotal skin. On coughing, the veins swell more, and give a slight impulse; on lying down, they slowly and almost imperceptibly empty, very unlike the manner in which a hernia

suddenly slips back. The pressure of a finger on the external abdominal ring will at once cause them to become full and distended.

Though painless in the robust and the healthy, in weak, anæmic, and easily-fatigued men varicocele causes an aching in the testis, cord, the groin, and loins, and gives rise to a sense of weight and dragging, and occasionally even to a severe spasmodic pain along the cord. In some cases, also, it gives rise to severe mental despondency and dread of impaired virility. Long standing, walking or riding or any sudden exertion aggravates the swelling; hence the increased discomfort often felt towards evening.

It usually appears at or within five or ten years after puberty, though in most instances it probably exists potentially from birth.

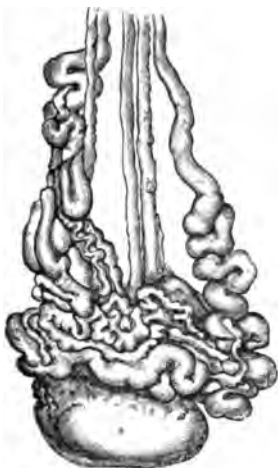


Fig. 922.—Varicocele.

It comes on painlessly and insidiously, and is first noticed as a swelling on account of the testis hanging lower and the scrotum becoming relaxed. If the veins enlarge before or at puberty the perfect development of the testis may be interfered with, and as a consequence the left may be smaller and softer than the right; if they do not enlarge until some few years after puberty, the growth of the testis is not affected, though the organ may feel less firm and elastic, as its nutrition and function are somewhat impaired by the stagnant condition of the blood within it.

Treatment may be either palliative or operative. In the large majority of cases simple *palliative treatment* is all that is required, and by it all symptoms are kept in abeyance. More than this is not needed, especially as, as has been

already mentioned, varicocele tends to retrograde spontaneously as age advances.

In all cases a well-fitting suspensory bandage should be worn: the bowels should be daily and regularly opened, so as to avoid the effect of straining upon the veins passing through the inguinal canal; and night and morning a cold or chilled bath, or cold sponging about the genitals and groin, should be employed. A tonic will often be of service. If pain is severe it should be combated by the same methods of treatment as those adopted for neuralgia of the testis. (See page 969.) Sexual hypochondriasis must be combated by encouragement and assurance that no ill consequence is to be feared.

Operative treatment is justifiable when varicocele is a bar to a young man entering the army, or navy, or police force, or from following any active occupation to which he wishes to devote himself. It is beneficial if the varicocele causes much pain or

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physical distress, and also if, by its increase, atrophy of the testis seems to be threatened.

By operative treatment a radical cure is obtained. Two chief methods are employed—either subcutaneous ligature, or excision of the affected veins. For the details of these operations the student is referred to works on operative surgery. Suffice it to say that though a great many surgeons prefer the open method of operating, still subcutaneous ligature has much to recommend it, being equally effective in its results, and without the necessity of an open wound in a part not always easily kept aseptic.

INJURIES AND DISEASES OF THE VESICULÆ SEMINALES.

Injuries to the vesiculæ seminales are especially rare. They have been, however, produced by firearms, fracture of the pelvis, particularly of the ischia, and in the course of surgical operations.

Anomalies and atrophy.—The vesiculæ seminales are sometimes absent; but they are not invariably so, even when the testicle, epididymis, and lower part of the vas deferens of the corresponding side are wanting. In persons who have neither testis, epididymis, nor vas deferens, there may be ejaculatory power, the ejaculated fluid being merely the secretion of the vesicula unmixed with spermatozoa.

Atrophy is a result of inflammation and of old age; but castration is by no means constantly followed by wasting of the vesicula seminalis.

Inflammation.—This may be acute, subacute, or chronic, and may be caused by gonorrhœa and other forms of urethritis, by stricture, catheterisation, impure or excessive coitus, or by extension of inflammation from prostate or bladder.

It is generally overlooked through want of proper rectal examination, and is sometimes mistaken for prostatitis.

Symptoms.—Sometimes the disease begins insidiously; generally, however, there has been for a few weeks a urethral discharge, then ensues pain of varying intensity in the groin of the side affected, in the hypogastrium and perinæum. Pain may also be referred to the sacrum and the hip, and is then likely to be mistaken for the pain of hip-joint disease, or to the loin when it excites suspicion of renal calculus. The pain varies in character as well as in degree, and is aggravated by defecation and micturition. Micturition in many cases is frequent, and accompanied by straining. There may be retention of urine, or rectal tenesmus with diarrhœa, and discharge of blood and pus from the urethra. Blood and pus may be mixed with the first ounce or two of urine or may escape by itself from the urethra. In some instances persistent priapism, or frequent blood-stained seminal emissions occur.

On rectal examination one or both vesicles can be felt extending obliquely upwards from the upper edge of the prostate. The swellings are more distinctly made out when the bladder is full, or a sound

is passed into the bladder. Their consistence will depend on the degree and character of the inflammation. They may be hard or brawny, or, if there is pus, fluctuation may be detected. Tenderness will be marked if the inflammation is acute.

Several complications may arise if the inflammation runs on to suppuration, such as (a) burrowing abscesses between rectum and bladder; (b) peritonitis from extension of inflammation or by bursting of the abscess into the peritoneal cavity; (c) pyæmia; (d) irritability of bladder.

Diagnosis must be made from prostatitis: from inflammation of the deep urethra; from cystitis; from renal calculus and tuberculous kidney; and from hip-joint disease.

The frequency of micturition, the presence of blood and pus in acid urine, and of pain in the groin and loin, are very likely symptoms to excite suspicion of stone or tubercle in the kidney. The only way to clear up the diagnosis is by digital examination by the rectum.

Treatment of acute and subacute inflammation consists in frequent hot hip baths, fomentations to the hypogastrium and perinæum, a restricted, unstimulating diet of soup, milk, and light puddings, and the internal administration of mild saline aperients and anodynes, such as belladonna, opium, or morphia. Leeches to the perinæum are of much service in the early stage. If retention of urine occurs a soft catheter should be passed.

As soon as suppuration has occurred, as shown by the intensity of the local and general symptoms, and probably by rigors, the pus should be evacuated, either by an incision from the perinæum with a long narrow bistoury introduced one inch in front of the anus, and a little to one side of the middle line, and guided by the left index finger in the rectum; or by an incision through the rectum.

Chronic inflammation, the result of an acute or subacute attack, is best treated by attention to the general health, avoidance of sexual excitement and alcohol, combined with cold douches, sea-water bathing, and tonics.

Dilatation and cysts of the seminal vesicles.—These conditions, due to obliteration or obstruction of the excretory ducts, may arise from chronic inflammation. In some cases the vesicle is dilated into one large unilocular cyst; in other cases, namely, those in which there are obstructions at the openings of several of the smaller ducts, instead of in the main duct, there is an aggregation of cysts instead of a single cyst. The single cystic dilatations cause larger swellings than the multilocular, but either may give rise to irritation of the bladder and obstruction to the urine in the same way as an enlarged prostate. The cysts contain mucoid fluid of various colours, and often well-formed spermatozoa may be found in the same vesicles. They have sometimes attained a great size and caused large pelvic swellings.

Concretions.—These form occasionally in the seminal vesicles. They are at first soft and whitish, and consist of masses of mucus,

spermatozoa, and epithelium; after a time they become yellowish-brown or brownish-black, and they may be coated by deposits of phosphates and carbonate of lime. They are usually multiple, and may occur at any period of manhood. They are one cause of organic aspermia, and are produced either by obstruction to the ducts or to undue viscosity of the contents of the vesicles.

Tuberculous disease.—This is rare as a primary disease, but occurs fairly frequently as a sequel of tuberculous disease of the epididymis or of the prostate. The diseased condition may be diagnosed by rectal examination. If the so-called abscess stage is reached, the matter may burrow and open into the rectum by sinuous fistulous tracks.

Treatment.—As the disease is generally secondary, the only treatment is palliative. But in primary disease the affected vesicle might be removed through a semilunar incision in the perineum after detaching the rectum from the prostate.

New growths.—Carcinoma and sarcoma have been met with very rarely, but in most cases have been secondary to, or actual extensions from, similar disease in the prostate or bladder.

INJURIES AND DISEASES OF THE PENIS.

Wounds of the penis.—These may be contused, punctured, incised, or caused by gunshot. If the wounds involve the deeper tissues of the penis severe hæmorrhage results and much blood may be extravasated into the corpora cavernosa or corpus spongiosum, forming a large hæmatoma. If the corpus spongiosum is wounded the urethra will probably also be involved, in which case an immediate symptom is dysuria from retraction and spasmodic contraction of the urethral walls; whilst later a troublesome traumatic stricture will result. After wounds or extravasation of blood into the sheaths of the corpora cavernosa, permanent distortion of the penis may result.

Treatment.—In incised wounds every care should be taken to unite the cut surfaces accurately by buried and deep sutures. If the urethra is wounded, its edges must also be accurately approximated, and a catheter passed and retained until healing is completed. If a large hæmatoma has formed within the sheaths of the corpus cavernosum, it should be incised and the blood-clots turned out, any bleeding point arrested, and the wound irrigated, and treated aseptically.

Fracture of the penis.—This is caused by the forcible pressure and sudden incurvation of the penis against some resisting surface. The sheaths of the corpora cavernosa are thus ruptured. The accident most frequently occurs when the penis is in the erect state during coitus or attempted coitus.

Symptoms.—The symptoms are a sudden acute pain, followed, it may be, by syncope. This pain is most intense at the level of

the fracture, but radiates to the pubes and thighs. It is instantaneous, and accompanied by a dry crackling sound and an immediate cessation of erection. After a while the organ swells enormously, and the skin of the penis becomes darkly mottled, from extravasation of blood into, and superficial to, the cavernous tissues. Sometimes rupture of the urethra complicates the fracture of the cavernous bodies, and dysuria and infiltration of urine follow.

When the swelling subsides and the penis has regained its natural size, it will be found that erection is no longer natural. Either the part of the penis behind the fracture becomes turgid and the part in front remains entirely flaccid, or the anterior portion stiffens some time after the erection of the posterior part is complete. These physiological digressions result from the organisation of blood-clot and the formation of sclerosed tissues.

The **treatment** should be directed against these after-consequences. With this object in view it is best to make an incision,

turn out the blood-clots, ligature any bleeding vessels, and after antiseptising the wound, to unite the parts by sutures and apply an antiseptic dressing around the penis.

Dislocation of the penis (Figs. 923, 924).—Some five or six cases have been recorded in which the glans and body of the penis have been stripped of their coverings, which have remained in position looking like blown-out gold-beater's skin, whilst the penis has been lodged beneath the scrotal tissues, or in front of the pubes, or on the crease of the groin. The urethra in one case was ruptured, and urinary infiltration followed.

Absence of the penis.—

In the rare instances of entire absence of the penis, the urethra has opened on the anterior wall of the rectum, or just outside the sphincter ani. The scrotum and testes may be well developed and natural. In some cases umbilical or inguinal hernia, spina bifida, or talipes has co-existed. In a few cases in which the penis was apparently absent it has been found beneath the skin in the lowest part of the abdomen, and in a rudimentary state.

The prepuce may be congenitally absent, or there may be an incomplete or complete division on one side or on the dorsal aspect. Sometimes the frænum is abnormally short.

Congenital defects.—The penis may be defective in size and

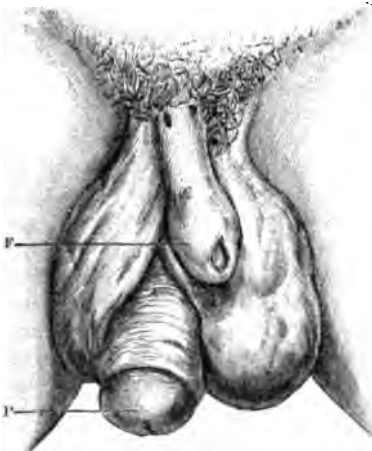


Fig. 923.—Dislocation of penis. (King's College Hospital Museum.)
F, Foreskin and skin of penis from which P, the penis, has been displaced.

shape. One or both corpora cavernosa may be absent, or very imperfectly developed, the penis thus feeling like a tube of skin. A webbed condition between the penis and scrotum (what the French call *pénis palmé*) has occasionally been met with. The inferior part of the penis alone may be adherent to the front of the scrotum, or the whole penis except the glans may be enclosed by the scrotal skin. Hypospadias may complicate the webbed penis.

Torsion of the penis.—This sometimes complicates hypospadias and epispadias. It sometimes occurs independently of either of these urethral defects. The urethra may turn spirally round one of the corpora cavernosa, or the whole penis may be twisted on its own



Fig. 924.—Dislocation of Penis into the right Groin in a Boy aged 14, under Sir W. Fergusson. (King's College Hospital Museum.)
o is an orifice in the skin from which urine escaped. The penis was dissected out and replaced in its normal position.

axis. Torsion of the penis is perhaps explained by the outgrowth of one of the genital folds causing the genital tubercle or eminence to deviate on one side and thus twist on its own axis.

Double penis.—This is a very rare condition, but a few cases have been recorded. In some, both penes were well formed and discharged urine and semen.

Congenital fistula of the penis.—Cases are described in which a minute fistula opened either behind the corona or just in front of the pubis, or in a single or in multiple orifices near the urethral meatus in the glans. These do not communicate with the urethra.

Phimosis.—This is the term applied to the inability to retract the prepuce. The condition may be congenital or acquired.

Congenital phimosis.—This results from a too narrow preputial orifice, or from the persistence of the natural epithelial adhesion which exists at birth, and for some time later, between the prepuce and the glans penis.

Another condition which aggravates either of the above, and may of itself be a cause of phimosis, is a too elongated prepuce. At

birth there is a natural adhesion between skin and glans, which, as a rule, spontaneously disappears in a year or more.

Symptoms.—Children with a very narrow preputial orifice, or a very long or unduly adherent prepuce, suffer from frequent micturition, incontinence, pain and difficulty in passing water, and sometimes from retention. The prepuce is frequently dilated or ballooned by the urine during micturition, and the straining to pass water often gives rise to hernia and to prolapsus ani. It is remarkable how soon after circumcision the hernia disappears in some of these cases.

If the phimosis persists, the constant and forcible efforts of the bladder to expel urine cause, after a time, hypertrophy and fasciculation of the bladder walls and dilatation of the ureters and kidneys. Other results of phimosis are preputial calculus, balanitis, thickening and hypertrophy of the prepuce, premature sexual excitement, and masturbation, convulsions, epilepsy, simulated or actual hip disease, talipes, interference with due development, and peevishness and loss of appetite.

In the adult, paraphimosis, rupture of the frænum, balanitis, atrophied and ill-developed glans, epithelioma, and difficult and imperfect coitus are consequences which may arise from congenital phimosis.

Treatment.—If the foreskin is not unduly long and the orifice not contracted, it suffices—by means of a probe, director, or the fingers and a little oil—to detach the adhesions between the prepuce and the glans penis, and then daily dress the parts with a little boracic ointment or white vaseline. But if the prepuce is disproportionately long, if the preputial orifice is very small, if the adhesions cannot be separated, or, having been separated, are allowed to re-form from carelessness or tender-heartedness on the part of the nurse; if œdema or troublesome cracks and fissures follow the detachment of the adhesions, and if balanitis or hernia complicate the phimosis—circumcision ought to be performed.

This operation, insignificant as it is deemed to be, yet requires care and judgment in its performance; otherwise one of several complications may occur. Insufficient removal of either skin or mucous membrane leaves the patient in as bad a state after as he was before the operation. I have had to operate on several occasions where a mere ring of skin only had been cut away, and then the cut edges had been united, leaving the narrow orifice of the prepuce just as it was before the operation.

There may, on the other hand, be a too free removal of skin, so that the penis becomes curved by the subsequent contraction of the cicatrix.

Cellulitis and erysipelas may follow, unless scrupulous attention is paid to asepticity before, during, and after operation, and unless the patient is placed in good sanitary surroundings. Sir James Paget has recorded a case in which, owing to defective sanitary surroundings, sloughing of the integuments of the penis and scrotum followed the division of the phimosed prepuce.

Infection of the wound with syphilitic or with tuberculous virus has again and again occurred by the saliva of the priest when the operation is performed, as practised by the Jews, or from the use of impure instruments or dressings. Hæmorrhage is a great source of risk if the operation is done on a member of a family of "bleeders"—i.e. the subjects of hæmophilia.

Acquired phimosis.—Men with a slight degree of congenital phimosis, and those with an elongated prepuce, are prone to get an aggravation of the condition following repeated attacks of balanitis, gonorrhœa, or chancre. The cracks and excoriations that result from over-acid urine in men past middle life, and from diabetes; and the œdema of the prepuce which results from thrombosis of or pressure upon the prostatic venous plexus, bring about a phimotic condition that requires circumcision or constant palliative treatment.

Paraphimosis.—This name is given to the irreducibility of the prepuce after it has been retracted behind the glans penis.

It occurs during masturbation, coitus, or when a prepuce with small orifice is pulled back for the purpose of washing the parts.

It may produce symptoms of an acute, subacute, or chronic kind. When acute or subacute, the condition is serious, and, unless relieved by the surgeon, must end either by ulceration of the constricting ring of the prepuce, or by mortification of the strangulated glans penis. The latter is less frequent than the former. The strangulating ring may be situated immediately behind the corona, and consist of the mucous fold of the prepuce. It is most marked on the under aspect, but surrounds the organ like a purplish-red œdematous collar; or it may be situated farther back, and will then consist of the preputial orifice. The glans penis swells often to a very great size, and looks œdematous and dusky red or purplish black in colour.

In the chronic form there is no inflammatory swelling, and but little œdema; it may occur as the result of the subacute variety or independently.

The **treatment** consists in reducing the prepuce, after well oiling the parts, by dragging it forwards between the index and middle fingers of both hands, made to enclose the penis, one pair of fingers in front of the other, and then by squeezing and pressing backwards the glans penis with the thumb.

If this does not succeed, the constricting band or bands should be thoroughly divided by a sharp scalpel in the axis of the penis, and on the dorsal aspect after well washing the parts with antiseptic lotion. After freeing the glans of all constriction, punctures should be made into the œdematous prepuce, and the whole organ should be wrapped in lint soaked with antiseptic lotion, and elevated upon the abdomen.

Preputial calculi.—When phimosis exists, concretions can be lodged within the sacculus formed by the prepuce and there grow. They are met with most frequently in adults, less so in children, and rarely in old age. They may be faceted and multiple, or oblong or

oval, and as large as a sparrow's or bantam's egg, or larger. Some are derived from the urine salts, and are formed originally in the kidney or bladder, pass along the urethra, and thus reach the sub-preputial space. Others are formed in this space by deposition of the salts from the urine, which are retained there owing to a phimosed prepuce. Such calculi are composed partly of uric acid and urates and partly of phosphates.

Other preputial calculi are concretions of smegma, impregnated with lime salts deposited from the urine, which is retained behind a phimosed prepuce. Such concretions are soft and easily crumble, and consist of epithelium, cholesterin, and lime salts.

Balanitis and balano-posthitis.—By balanitis is meant inflammation of the glans penis. By posthitis, inflammation of the inner or mucous surface of the prepuce. The two conditions most frequently coexist, and are therefore spoken of as *balano-posthitis*.

It occurs from want of cleanliness, and is predisposed to by phimosis, gonorrhœa, subpreputial chancres, and over-acidity of urine as in the gouty and the diabetic.

Symptoms.—It gives rise to a sense of burning and itching, and the glans penis and inner aspect of the frænum are red, glazed, and covered by an offensive yellow secretion consisting of decomposed smegma, epithelium, and pus. The epithelium may become detached, and the surface of the glans and inner aspect of the prepuce then look superficially excoriated.

Diagnosis.—With a very phimotic prepuce there may be some difficulty in forming an opinion as to whether the discharge comes from the urethra or from a chancroid sore, or is due to balano-posthitis. The peculiar and disgusting odour of balano-posthitis, and the absence of heat and pain along the urethra during micturition, will exclude urethritis. When a chancre is present, it can, as a rule, be detected as a tender and perhaps indurated spot by squeezing the several parts of the foreskin between the finger and thumb, and there will in all probability be some inflamed glands in one or both groins. The inguinal glands may, however, be inflamed in balano-posthitis, but much less frequently. The division of the prepuce will at once make clear any case that cannot otherwise be diagnosed.

Treatment.—This consists in cleanliness, frequent syringing with a lotion of bicarbonate of soda, or a warm boracic or weak mercuric lotion, and if this does not effect a cure the surface should be rubbed over with a stick of nitrate of silver. Other remedies failing, the prepuce should be slit up and the inflamed surface lightly touched with nitric acid.

It should be remembered that prolonged balanitis, in elderly men, may run on into epithelioma, and this is, therefore, all the stronger reason for efficient treatment.

When due to diabetes, the diet and medicinal treatment suitable to this disease, aided by cleanliness and the local application of dry boracic powder, will generally suffice to cure the inflammation.

Circumcision and slitting up the prepuce should be avoided in such patients if possible. All diabetic patients bear operations, even the slightest, badly. When due to gouty causes, the remedies suitable to gouty patients should be employed.

Herpes progenitalis or preputialis.—Herpes zoster affecting the area of the ilio-inguinal nerve may attack the penis; but the more common form of herpes is of an erythematous order and of a more local character, and as it affects the glans penis as well as the prepuce, it is better named *H. progenitalis* than *H. preputialis*.

Symptoms.—It commences with itching and a sense of heat upon an erythematous patch of prepuce or glans penis, and soon afterwards one or several papules, changing into vesicles and then into pustules, appear on this patch. As the pustules shrivel, small excoriations are left, which heal in five or six days from the appearance of the papules. As a rule, to which, however, marked exceptions now and then occur, there is not much if any pain, and the patient usually seeks advice, fearing the eruption may be of a venereal character.

There is a great disposition for herpes to recur at intervals of a few weeks, and to go on doing so for a long time, until the disease wears itself out by degrees, and then ceases for several years, and until some venereal attack starts it afresh.

Diagnosis.—There is no difficulty in diagnosing an uncomplicated case. Soft chancres will be distinguished from herpes by the larger size, greater depth, and more scattered distribution of the ulcers. A herpetic sore may become the seat of inoculation, or a herpetic vesicle may appear upon the spot at which the syphilitic virus had previously gained entrance, so that in either case the herpes may take on the specific characters.

Treatment.—A purge, some cooling saline mixture, and restricted or, at any rate, properly regulated diet, together with the local application of a little Goulard lotion or boracic powder, are the simple remedies required for most cases. Where there is a disposition to recurrence, any gouty or other constitutional tendency should be attended to, the bowels and liver should be kept regularly in action, and some astringent wash daily used for the glans and prepuce.

Lymphangitis.—This occurs in two forms, either as a single inflamed lymphatic or as an inflamed network of small lymphatics. It arises usually from balano-posthitis or acute phimosis. When one lymphatic is inflamed it presents as a hard cord, which is to be distinguished from phlebitis by it being on one side instead of in the middle line of the dorsum, and by it being directed towards the inguinal glands instead of under the pubes, as is an inflamed dorsal vein.

Treatment.—Saline purges, lead lotion, and the horizontal posture are indicated.

Erysipelas, cellulitis, and gangrene.—These diseases may attack the penis at the outset or may spread to it from neighbouring parts. When they occur after circumcision, especially in weakly or

dirty children, they may run on to gangrene so, may spread and prove fatal.

The course, prognosis and treatment of them when they affect the penis are much the same as when they affect the extremity.

Affections of the blood-vessels.—Such as occur on the penis. They rarely, if ever, involve the life, but may be cured early by galvano-puncture or electrolysis. They are apt to spread and cause irritation, and may lead to masturbation.

Varicose veins are not very infrequent, but are inconvenient and need no treatment.

Tuberculosis.—Tubercle, as has been said, may be inoculated by the saliva of a Jewish rat. It is known to commence in the glans penis with the formation of a chancre.

Elephantiasis.—This disease may affect the penis in conjunction with the scrotum. (See Elephantiasis.)

Sebaceous cysts.—These occasionally occur on the penis for which circumcision is the best treatment. The glands behind the corona have sometimes single and as large as a hen's egg, and varying in size from a shot to a horse bullet. They are excised in the usual manner for sebaceous cysts.

Papillomata.—These may be either of venereal or non-venereal origin, and are produced by the use of mercury and discharges; but they may arise from the corona, and from those of the glans and inner surface of the prepuce without any venereal origin. They form small, slightly pedunculated, flabby, and foully smelling tufts. The proper treatment is to remove them with scissors curved on the flat, taking care to remove the mucous membrane from which they arise, and to rub the raw surface with strong nitric acid.

This treatment should be carried out with care, and the patient anæsthetised. In the case of the drier variety, the patient dreads an anæsthetic, an attempt may be made to destroy them by calomel dusted over their surface, or by the application of glacial acetic acid or the acid test solution. It is essential that they should all be thoroughly removed, and a fresh crop will spring up from the portions left behind. It is borne in mind that primary epithelioma may arise from elsewhere, from the first, assume a papilloma form, and then become cancerous.

Keratomata, or horns, are occasionally developed from the prepuce or glans, and are developed from a sebaceous cyst. They rarely attain to the size of a finger, but they form flat plates or slightly curved plates, less, striated, with a tendency to split, and are of a dirty brown colour. They are often associated with gonorrhoea or acquired. The proper treatment is to remove them with scissors curved on the flat, taking care to remove the mucous membrane from which they arise, and to rub the raw surface with strong nitric acid.

prone to ulcerate around the base and to be followed by epithelioma.

Gummata are very rare ; they have, however, been described as occurring, not only in the glans and the other erectile portions of the penis, but in the prepuce and skin covering the body of the organ. They should be treated actively at first by potassium iodide, and if they do not yield under the drug, circumcision, excision or amputation should be performed. There is danger that the gumma or the scar of a gumma may pass into epithelioma.

Priapism.—This is a condition of continued erection apart from any sexual desire. When complete it is very painful ; when incomplete not so. The corpora cavernosa are the parts affected. The corpus spongiosum generally is unaffected. It is produced by injury to the erectile parts of the penis, by excessive venereal indulgence, by leukemia, in which disease it is caused rather by effusion of blood into the corpora cavernosa, or by the formation of thrombi owing to the great excess of white corpuscles ; and in children by phimosis, stone in the bladder, and worms. Injuries to the cervical and upper dorsal parts of the spinal cord cause only incomplete priapism—i.e. turgescence without rigidity.

The duration of priapism varies ; it often lasts from three to six weeks, and may continue for as many months.

Treatment is unsatisfactory. Tartar emetic, mercury, bromide of potassium, belladonna, leeches, and strapping have all proved useless. Camphor, belladonna, or morphia is needed to procure sleep. Incisions have been employed with some success, and deserve a further trial. When due to injury of the spinal cord, no special treatment for the priapism is required.

Malignant disease of the penis.—Squamous-celled carcinoma, or epithelioma, is the usual form of malignant disease. A few cases of primary sarcoma of the penis originating in the erectile structures have been recorded.

In comparison with carcinoma of other organs, that of the penis is not very frequent.

Epithelioma of the penis commences in a nearly equal number of cases on the prepuce and on the glans, the prepuce being perhaps somewhat more often than the glans the starting-point.

Causes.—Epithelioma of the penis is a disease of late middle and advanced age, though it has fairly often been observed in men under thirty-five, and still more often under forty-five. Phimosis is a very pregnant *cause*, leading as it does to deformity, stunted growth, and irritation from retained secretions of the glans penis. Warts, chancres, the contracted scars of chancres, and every form of chronic irritation, such as gouty balanitis, sores, or cracks about a too short frænum, and the irritation of a urinary fistula, are other causes of epithelioma.

Symptoms.—These differ in quite the early stage, according as the disease commences as a warty excrescence, or as a subcutaneous lump, or as a raw or blistered patch. But in whatever way the

disease begins, its course becomes the same in all cases; an ulcer soon forms, and cauliflower-like excrescences arise here and there upon the epitheliomatous ulcer. The ulcer varies in depth in different parts, its edges and base are very hard, the base being more or less fixed, and the edges more or less everted; the surface may be sloughy or ashy-grey, or nodular, or covered with exuberant granulations that bleed readily and scab over, forming a crust from beneath which a foul sanious discharge escapes.

The disease tends to spread locally, and though for a time resisted by the fibrous sheaths of the corpora cavernosa, it does at length eat its way into the cavernous tissue and there spread rapidly, entirely destroying the natural spongy character of the tissue. Separate isolated nodules of squamous epithelioma may be found in the corpora cavernosa at a considerable distance from the original mass of disease.

As it is at the prepuce or glans that the disease generally begins, it is here that the chief mass of it is found, and sometimes the extremity of the penis is increased several inches in circumference. As a rule, the urethra escapes, and no obstruction to the outflow of the urine occurs. Occasionally, however, the urethra just behind or in the glans becomes perforated, and an urinary fistula is established in the floor of the urethra.

There is but little if any pain as a rule till ulceration has extended; pain then of a shooting and burning character occurs in the part, and radiates to the penis and perinaeum. There is often a slight amount of bleeding, but severe hæmorrhage is rare. One of the most marked features is the discharge of a foul, fetid, and abundant sanious fluid.

The inguinal glands are usually affected early in the course of the disease, and this is especially the case when the disease commences under the prepuce, where the warmth and moisture favour its rapid advance.

Diagnosis.—When the disease commences as a wart, by the time it becomes hard at the base and characteristically ulcerated on its surface the disease too often has already invaded the lymphatics, and the most favourable time for operation has passed. Before the wart has become indurated and fixed at its base the only reliable means of diagnosis are the microscopical appearances, and the beneficial effect of cleanliness and treatment, or otherwise.

When the disease commences as a subcutaneous pea- or bean-sized nodule it ought to be diagnosed as malignant at once.

Between cancer and primary chancres, or the sores of late syphilis, the effect of a fortnight's treatment ought to settle the doubt. It should never be forgotten that an obstinate tertiary syphilitic sore on the penis, as on the tongue, leg, or elsewhere, is very prone to pass into an epitheliomatous growth. No time should be lost, therefore, in operating upon a doubtful ulcer that does not improve under specific treatment.

In all cases where an induration or a sore exists beneath a

phimotic prepuce, the prepuce should be slit up and examined ; or if the whole of the disease can be removed with the prepuce, circumcision should be performed.

Treatment.—In any case of doubtful wart or ulcer that has resisted the ordinary treatment of cleanliness and suitable local applications for a few days, and has persisted or returned after having been freely treated by acid nitrate of mercury, or fuming nitric acid, nothing remains to be done but the complete and wide removal of the diseased tissues.

The amount of penis to be removed depends entirely on the extent to which it is invaded. In some cases amputation may be safe just behind the glans or through the organ half way between the pubes and the glans ; or it may be required immediately in front of the pubes, or even still farther back, so that the whole of the erectile structures are taken away, including the crura penis and the bulb of the urethra.

If the inguinal glands are enlarged, they must be freely removed. But when these operations are undertaken, the surgeon must be prepared for extensive and complicated dissections exposing the saphena vein and femoral vessels and the anterior crural nerve.

LIII. INJURIES AND DISEASES OF THE FEMALE GENITAL ORGANS.

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THE female genital organs may, for descriptive convenience, be divided into the following parts—the vulva, including the perinæum and hymen; the vagina; the uterus; the Fallopian tubes; the ovaries; and the broad ligaments.

Before discussing the various injuries and diseases to which these parts are liable, it will be necessary to consider the methods usually employed in their physical examination.

Methods of examination.—The complete physical examination of the female genital organs requires to be conducted in a systematic manner. Such investigations involve—(1) an examination of the abdomen; (2) an exploration of the vagina; (3) an inspection of the vulva. (*See also page 660.*)

1. Abdominal examination.—Whenever it is possible the patient should be undressed; nothing is so unsatisfactory as examining an abdomen to ascertain or disprove the existence of a tumour when the hips and waist are encumbered by partially loosened skirts, stays, petticoats, and other garments. It is useful to advise the patient to have the rectum emptied by an enema some hours before the examination is to take place, and to empty the bladder shortly before the inspection actually begins. Neglect of these two simple measures has been a fertile source of inexcusable blunders in diagnosis.

The patient should lie on her back upon a bed or couch, with her legs slightly flexed and her head resting upon a pillow; the legs should be covered with a blanket or counterpane, and the room should be comfortably warm. The surgeon should be careful that his hands and finger-tips are warm, as cold fingers produce uncomfortable sensations when placed on the abdomen, and hinder a proper examination.

Inspection.—The practised eye quickly notes alterations in contour, the presence or absence of a linea nigra, or lineæ albicantes, signs of great value in indicating previous distensions of the belly.

Recent lineæ albicantes are glistening and pearly; old lineæ are dull white, like stars.

Palpation, which should be gently performed with both hands, quickly teaches whether swellings are hard or soft, tender or obtuse, mobile or fixed, regular or irregular, nodular or smooth, as well as conveying the sense of fluctuation, which indicates the existence of fluid, and often enables the surgeon to determine whether it be free or confined (encysted).

Percussion furnishes valuable evidence; by this means the surgeon determines whether a swelling is simply due to intestines distended with gas, or some more tangible material or fluid. Skilful percussion gives information of the extent of a swelling, and, in the case of fluid, whether it be free or encysted.

Auscultation is occasionally of service for differential diagnosis, especially when pregnancy, normal or abnormal, is suspected; it is also useful in other cases.

After carefully noting all that an examination of the abdomen furnishes, the surgeon proceeds to examine the patient by the vagina.

2. Vaginal examination.—Investigation of the pelvic organs by this method is inadmissible in the case of girls and unmarried females, unless there be good reasons.

In young women the condition of the pelvic organs can be ascertained by examining them through the rectum when the hymen is intact. Perhaps the most convenient, and certainly the most delicate method of conducting a vaginal examination on a conscious patient is to place her on the left side, with the legs flexed, and the hips well drawn over the side of the bed or couch, and covered with a sheet. The index finger of the right hand, anointed with vaseline or soap, is introduced into the vagina. The surgeon follows with his finger the fold of the buttock until he reaches the anterior edges of the perinæum. As the finger enters the vulva and passes into the vagina, information is acquired as to the character of the vulval orifice, the breadth or narrowness of the vagina, etc. The cervix is then sought, and its position and character determined. The finger then sweeps the vaginal fornices to ascertain the presence of any painful swelling, thickening, etc., and to notice their mobility, fixity, and relation to the uterus. In order to gain more accurate knowledge of the relation of swellings or tumours in the pelvis, the surgeon resorts to the *bimanual method*. The patient turns upon her back, and the index finger of the right hand is introduced into the vagina; the fingers of the left hand are placed upon the abdominal wall immediately above the pubes, and by steady pressure the various pelvic organs may be brought into contact with the finger in the vagina. The information furnished by this means is very valuable. The position and size of the uterus is readily determined, as well as its relation to surrounding structures. In many cases, especially in thin patients and those with lax abdominal walls, it is possible to raise the ovary out of the pelvis by means of a finger in

the vagina, and then examine it with the finger-tips of the left hand, pressing on the anterior abdominal wall.

It is universally admitted that the bimanual is the most satisfactory method of examining the pelvic organs of women.

In a large number of cases digital exploration furnishes sufficient evidence, but there are many in which more detailed information is required; then it is necessary to seek instrumental aid. Two very useful instruments are the vaginal speculum and the uterine sound.

The speculum.—There are many varieties of this instrument, but the two most useful are the duckbill (or Sim's) speculum and the tubular (or Fergusson's) speculum. It is unnecessary to describe these instruments, as they are best studied in the out-patient room and operating theatre, where they are always to be found. By means of a speculum, especially the duckbill, all parts of the vagina and cervix are actually exposed to view, and the presence and nature of diseased conditions recognised and their relations determined. In order thoroughly to expose the uterine cervix with a duckbill speculum, it is usually necessary to draw it into view with a volsellum. A speculum should be immersed in warm water before being introduced into the vagina.

The uterine sound.—This instrument is occasionally of service, as it enables the surgeon to determine the exact position of the uterus when it is displaced by tumours; and gives accurate information in regard to the size of the uterine cavity. It is, however, an instrument which requires skill and care in its employment, for many serious and evil consequences have resulted from incautious use of the sound. It is also quite certain that at times it has prevented the perpetration of serious errors in diagnosis. It is an instrument that should be used with great caution and judgment.

3. Inspection of the vulva.—When patients complain of trouble referable to the vulva only, and of such a nature as to render an inspection of the parts desirable, it is most completely carried out with the patient lying on her back, and the legs drawn up and separated. In this way the labia, fourchette, the vulval and urethral orifices may be thoroughly inspected when the parts are exposed in a good light.

Occasionally it is difficult to make a satisfactory examination of the pelvic organs in a conscious patient, sometimes on account of the physical pain it causes, and often because of the rigidity of the abdominal muscles, or narrowness of the vulval orifice, or the vagina. In such cases where it is necessary to make a careful examination then the patient may have the advantage of an anæsthetic.

THE VULVA.

The parts usually included under this term are sometimes called the external genitals, and comprise the labia majora and minora, the clitoris, the vestibule and fossa navicularia.

Injuries.—The labia are liable to lacerations, which may be due

to falls upon pointed objects, kicks from brutal husbands, and cuts from potsherds when chamber-pots break whilst women are sitting upon them. Lacerations are sometimes produced during labour and the careless use of midwifery forceps. Deep lacerations of the labia are usually followed by free bleeding, as the parts are very vascular.

Treatment.—Free the part from clots and secure the bleeding points with forceps and ligatures; capillary oozing is easily controlled by firm sponge pressure. The parts must be kept strictly clean.

Hæmatoma of the vulva.—As the tissues of the vulva are very lax and vascular, it is not uncommon for injuries to produce extravasation of blood, which may cause the greater labium to attain a large size. These subcutaneous hæmorrhages are rarely troublesome, and usually subside with rest and the application of cold lotions, or perhaps an ice-bag. In cases where the blood persists, it may be evacuated; or if suppuration be established, the treatment is that applicable to an abscess.

Inflammations.—The vulva consists of vascular folds of skin continuous with mucous membrane. The cutaneous covering is, in the adult, furnished with hair and sebaceous glands. Unless women keep themselves scrupulously clean, the secretion from the sebaceous glands lodges in the recesses of the vulva; discharges from the vagina, such as mucus and blood, accumulate on the parts, act as irritants, and favour the development of inflammatory conditions, which have received a variety of names. Thus the labia are liable to eczema, boils, inflamed sebaceous follicles, and acne; irritating discharges from the vagina will cause them to become inflamed, œdematous, and painful. Erysipelas may attack the vulva, and spread to surrounding parts. Parasites, commonly known as crablice, infest the hair on the pubes and labia; in children, and sometimes in women, *vulvitis* is often due to the irritation of thread-worms straying from the anus, and wriggling about the vulva.

Treatment.—In cases clearly depending upon dirt and the infrequent use of water, good results immediately follow strict cleanliness and the use of mild astringents, such as lead or alum lotions. In cases where a follicle inflames and forms an abscess, a timely puncture with a sharp narrow-pointed scalpel, followed by warm fomentations, or bathing in tepid water, quickly relieves the pain and initiates recovery.

Gangrene.—This is rare; it may follow protracted labour, or be a sequel of small pox, typhus fever, and the exanthemata.

Noma.—This term is applied to gangrenous inflammation of the vulva, which occasionally occurs in ill-fed and neglected children; in many cases it is a sequel of scarlet fever or measles. The disease appears as an inflamed spot on one of the labia, which quickly spreads, causing the vulva to become swollen, œdematous, painful, and dusky red; it is accompanied by great constitutional disturbance, fever, and in acute cases the soft tissues rapidly necrose and slough, the ulceration extending to the thighs and abdomen;

symptoms of septicæmia quickly manifest themselves. (See p. 150, Vol. I.)

In mild cases, successful results have been obtained by means of the astringent, and the patient with a liberal and suitable diet.

In cases which recover, cicatricial adhesions of the vulval orifice are the result, and in some cases, in the life it leads to sterility and hæmatocolpos.

Syphilis.—This disease may manifest itself as a primary sore (chancre), or as mucous patches (gummata) are infrequent. In the late stages of syphilis, the appearance like the changes on the mucous membrane known as leucoplakia. The margins are prone to ulcerate. In new-born girls, coppery-red spots, characteristic of congenital syphilis, are frequent on the labia. (See SYPHILIS, p. 101.)

Lupus.—This affection, introduced into our literature by Matthews Duncan, is a disease to which the name lupus is commonly applied.

The disease is extremely chronic, and is characterized by enlargement of the labia and clitoris, the tissue becoming indurated, especially the skin and parts immediately adjacent, and resemble the condition of the skin in thickened parts are exceedingly liable to ulcerate. In typical cases all parts of the vulva are enlarged, but in some cases confined to the labia majora or labia minora, and in some cases limits itself to the clitoris. The disease is not contagious; it does not affect the general health, and enlargement of the adjacent lymph glands is not a necessary accompaniment. It must not be confounded with epithelioma.

Treatment.—Free removal of the diseased parts, and cauterisation of the exposed surfaces with iron and arsenic internally is recommended.

Elephantiasis.—This disease, fairly common in the East, is rare in Europe and North America. It is caused by obstruction of the lymphatics, which leads to enlargement of the connective tissue in the skin, and the skin becomes excessively large, and the surfaces present a peculiar tuberoso appearance. The labia minora are frequently affected, but in the majority of cases the labia majora, as well as the clitoris share in the enlargement.

The disease is most frequent during the summer months. Moderate enlargement of the parts does not produce much inconvenience, but when the mass is heavy, it produces much discomfort. Cases are known in which overgrown labia majora reach to the knees and weighing many pounds.

Treatment.—Free removal with the knife, and cauterisation with both methods combined.

Pruritus.—This is a symptom only, and is met with in diabetes, irritating vaginal discharges, eczema of the labia, threadworms when they wander from the anus to the vulva, parasites, etc. It is often complained of in elderly women, but on examination no cause is discoverable. The itching often comes on when the patients are in bed.

Treatment.—This consists in removing the cause whenever possible, and enjoining strict cleanliness and the employment of soothing lotions. In cases where no cause is obvious, very great relief may be afforded by the local application of cocaine, either as a lotion or an ointment. In many cases itching is allayed by keeping the labia separate from each other by means of strips of lint saturated with lead lotion, or even by anointing them with white vaseline.

Atrophy of the external genitals (kraurosis vulvæ).—In old age the labia majora atrophy so that the labia minora are no longer concealed. When the atrophy of the parts is excessive, it is sometimes termed kraurosis of the vulva.

Urethral caruncle.—This troublesome condition appears as a red vascular excrescence at the orifice of the urethra; it is usually sessile, but may be pedunculated. In size caruncles vary from a split-pea to a ripe cherry.

There is reason to believe that the starting-point of some, if not the majority of urethral caruncles, is the pair of small blind ducts found in the floor of the female urethra near its external orifice, and known as "Skene's tubes." These ducts are often the seat of troublesome inflammation, and it is a fact that the existence of caruncles is first detected by patients when they are the subjects of leucorrhœa, gonorrhœa, or some form of vaginal discharge. Occasionally the orifices of Skene's tubes may be actually demonstrated in the midst of a caruncle.

These excrescences are often exquisitely tender and cause pain, especially during micturition; when large they will lead to retention of urine. A caruncle occasionally produces vaginismus and pain during coitus. In some cases, however, they produce no symptoms.

Treatment.—The patient should be anæsthetised, and placed in the lithotomy position. The caruncle may then be destroyed with Paquelin's cautery, or dissected out.

In operating upon them, it is a good plan to search for the orifices of Skene's tubes, and if detectable, these ducts should be slit up, and the parts around destroyed with the cautery.

These caruncles are very apt to return unless freely treated; yet in excising them the surgeon must exercise care, for if he inflicts much damage on the urethra, incontinence of urine may ensue.

Tumours of the vulva.—The tumours to which the vulva is liable are lipomata, myxomata, sarcomata, epithelioma. With these must be included cysts and carcinoma of Bartholin's glands.

Lipomata.—These may arise in the fatty tissue of the mons veneris, or in the deep connective tissue of the labia, and some-

times form large tumours ; they are or must be exercised not to confound a s hernia (epiplocele) occupying a labium

Myxomata.—These usually assu tumour covered with rugose pigment other of the greater labia (Fig. 925).

Sarcomata.—A sarcoma of the and is usually a melanoma, and arises



Fig. 925.—Pedunculated Myxoma of the Labium Majus. (Natural size.)

tumour conjoin, forming a continuous due to exhaustion and distress, the res or the large vessels in the groin may b sudden profuse hæmorrhage terminate

Treatment.—Free and early reme recognised. Extirpation, to afford g out, if possible, before the lymph g nately, quick recurrence in the scar o

Affections of Bartholin's gl glands open in front of the fossa navic and the hymen. They are liable to i very exceptionally, are attacked by o other secreting glands, septic organi ducts of these glands and cause infla

and spreading to the capsule, cause a painful swelling to form in one or both labia. The swelling may be due to pent-up mucus or pus in the gland, and causes great pain, especially during micturition or walking; occasionally the inguinal lymph glands are enlarged.

It must be borne in mind that all localised inflammatory swellings of the vulva, however, are not due to these glands; many arise in the sebaceous glands, which are of very large size, especially in the lesser labia.

Treatment.—Free incision to allow the pus and pent-up inflammatory matters to escape, followed by warm applications and bathing, gives immediate relief. Should the swelling continue after the subsidence of the inflammatory signs, then the cyst wall must be deliberately dissected out. Uninflamed cysts require enucleation.

Carcinoma.—This is a very rare affection. A tumour forms in the labium in the situation of the gland, and gradually infects the inguinal lymph gland and disseminates. Structurally, it mimics the acini of Bartholin's glands.

Rupture of the perinæum.—This accident is a not infrequent concomitant of difficult labour, and is probably more common in the first than in subsequent labours. An invariable consequence of the delivery of the first child at term is laceration of the fourchette, and the tear may extend very deeply into the skin intervening between the posterior commissure of the vulva and the anus; in severe cases the laceration involves all the tissues of the perinæum, including the sphincter of the anus and lower part of the rectum. In such a case the vulval and anal orifices are directly continuous.

As lacerations of the perinæum are the direct consequences of normal or assisted labour, it is the duty of the practitioner, as soon as delivery is completed, thoroughly to wash the parts, and bring them into apposition by means of deep sutures. These primary operations are, in a very large proportion of cases, perfectly successful; the torn surfaces often adjust themselves to each other very accurately. Should union fail, slight degrees of rupture are rarely sources of inconvenience, but in the severe cases, especially when the anal sphincter is torn, much distress is the consequence; not only is there a sense of weakness of the part and often incontinence of fæces, but prolapse of the rectal wall, the uterus, or part of the bladder commonly occurs, and there is in addition sexual disability, which adds to the misery of these patients.

Fortunately, surgery is able to render great service, and secondary perinæorrhaphy is a very successful operation.

THE VAGINA.

Injuries.—The vagina is liable to injury during delivery, not only from the fœtus, but by the clumsy use of obstetric instruments. Serious injuries have been caused during rape, and by awkward efforts on the part of the male in the course of mutual coitus. First coitus is sometimes followed by severe and even perilous bleeding,

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especially when the laceration of the hymen extends to and involves the vaginal wall. Fatal injuries have followed the introduction of foreign bodies into this passage in outrages by brutal men, or by pointed instruments introduced by women in self-attempts to procure abortion ; or by insane women during fits of sexual frenzy.

Treatment.—This consists in the removal of the clots and deliberate search for the bleeding vessels, which should be compressed with forceps. Pressure applied direct to the lacerated surfaces by means of a hot sponge readily checks capillary oozing. Occasionally it is necessary to plug the vagina with strips of iodoform gauze. The subsequent treatment is that adopted for wounds in general.

Foreign bodies.—All the natural orifices of the body are liable to have foreign substances introduced in them ; this is exceptionally true of the vagina, not only in young and inexperienced girls, but in adult women. Young girls from sheer curiosity will insert hair-pins, pencils, pebbles and the like into the vagina, whilst older girls introduce fragments of sponge or cotton wool, for the purpose of preventing conception from illicit connection. Extraordinary objects, such as pomade pots, cotton-reels or spools, candle extinguishers, and small indiarubber balls have been removed from the vagina of matrons. Odd things such as a pipe bowl, thimble, pieces of metal, etc., have been thrust into the vaginae of low drunken women when rioting with men. Such bodies have remained undetected during many weeks. Obstetric practitioners are responsible for pessaries of curious shapes and varying thicknesses, which, after introduction, have been forgotten and remained for years in the vagina, and at last are re-discovered when profuse discharges, fæcal or vesico-vaginal fistulæ have led women to consult surgeons ; then the long-forgotten pessary comes to light, perhaps half destroyed or encrusted with phosphatic deposits. Most hospital museums contain a comical set of objects removed from this unnatural repository. On one occasion a woman was admitted into the cancer ward of the Middlesex Hospital with a certificate to the effect that she was suffering from "stone cancer." On examination the alleged cancer turned out to be a piece of brick.

It is useful to bear in mind that, when a healthy young woman is found to be suffering from a stinking vaginal discharge, it is exceedingly probable that she has a foreign body in this passage.

Vaginitis (kolpitis).—Acute inflammation of the vagina may follow a variety of causes. In young children it occurs occasionally as a sequel to the exanthemata. In adult women the most frequent cause is gonorrhœa ; absence of cleanliness ; the presence of foreign bodies, and the irritation of threadworms.

The patients complain of pain, discomfort, and usually of a profuse irritating discharge, frequent micturition and scalding pain during micturition.

On examination, the vaginal mucous membrane is red, injected (occasionally ulcerated patches are present), and very tender. The surface is covered with a muco-purulent discharge.

Treatment.—Rest in bed, saline aperients, total abstinence from alcohol, warm hip baths, and frequent douching with tepid water, or water lightly tinted with permanganate of potash. A weak solution of acetate of lead (1 gr. to the ounce of water) is very useful. It is sometimes of service to keep the vaginal walls separated by means of small cotton wool plugs steeped in glycerole of tannin and the like. Local treatment in these cases is always effective if it is thoroughly carried out.

Leucorrhœa.—This is a very vague term, and covers almost any muco-purulent discharge from the vagina, independent of its source. Often it is the residue of an acute gonorrhœal vaginitis, and is comparable to gleet in the male. Muco-purulent discharges from the vagina frequently accompany anæmia; often a chronic vaginitis accompanies catarrhal conditions of the mucous membrane of the cervical canal. Leucorrhœa is a frequent accompaniment of pregnancy. Fœtid discharges indicate cancer of vagina or uterus.

Treatment.—Extreme local cleanliness, attention to the bowels, gentle exercise, and abstinence from alcohol. The use of tonics, especially mild preparations of iron, or quinine and strychnine combined, usually improve the condition.

Leucorrhœa in children.—A muco-purulent discharge is not uncommon in little girls, especially those who are not kept strictly clean. The condition is important, as the discharge is not infrequently mistaken for gonorrhœa, and grave legal errors have been made in consequence. The disease may assume a very acute phase, and the inflammation extending to the vulva causes much distress, and leads anxious mothers to believe that the child has been raped. Occasionally vaginal discharges in children depend on tuberculosis of the uterus. It is often associated with thread-worms.

Treatment.—Absolute local cleanliness, attention to the bowels, and tonics, especially a combination of iron wine and cod-liver oil. When the local distress is great, the vulva may be dusted with oxide of zinc, or be anointed with boracic ointment, lanoline, etc.

Vaginismus.—This term is applied to painful reflex contractions of the muscles surrounding the orifice of the vagina when attempts are made to effect sexual congress. *Vaginismus* must be distinguished from *dyspareunia*, which signifies painful coitus. When vaginismus is pronounced, sexual conjugation is impossible. The muscles chiefly at fault are the levators of the anus.

Vaginismus may depend on irritable ulcers of the vulva, inflamed or incompletely ruptured hymen; irritable myrtiliform caruncles, urethral caruncle, a narrow vaginal inlet, and occasionally piles will provoke painful spasm of the levators of the anus. In many cases no obvious cause exists.

Vaginismus is most marked in newly-married women; careful examination of the vulva and anus will often reveal some local lesion to which appropriate treatment should be directed. If the trouble can be relieved, so as to allow of complete conjugation and

disease begins, its course becomes the same in all cases; an ulcer soon forms, and cauliflower-like excrescences arise here and there upon the epitheliomatous ulcer. The ulcer varies in depth in different parts, its edges and base are very hard, the base being more or less fixed, and the edges more or less everted; the surface may be sloughy or ashy-grey, or nodular, or covered with exuberant granulations that bleed readily and scab over, forming a crust from beneath which a foul sanious discharge escapes.

The disease tends to spread locally, and though for a time resisted by the fibrous sheaths of the corpora cavernosa, it does at length eat its way into the cavernous tissue and there spread rapidly, entirely destroying the natural spongy character of the tissue. Separate isolated nodules of squamous epithelioma may be found in the corpora cavernosa at a considerable distance from the original mass of disease.

As it is at the prepuce or glans that the disease generally begins, it is here that the chief mass of it is found, and sometimes the extremity of the penis is increased several inches in circumference. As a rule, the urethra escapes, and no obstruction to the outflow of the urine occurs. Occasionally, however, the urethra just behind or in the glans becomes perforated, and an urinary fistula is established in the floor of the urethra.

There is but little if any pain as a rule till ulceration has extended; pain then of a shooting and burning character occurs in the part, and radiates to the penis and perinaeum. There is often a slight amount of bleeding, but severe hæmorrhage is rare. One of the most marked features is the discharge of a foul, fetid, and abundant sanious fluid.

The inguinal glands are usually affected early in the course of the disease, and this is especially the case when the disease commences under the prepuce, where the warmth and moisture favour its rapid advance.

Diagnosis.—When the disease commences as a wart, by the time it becomes hard at the base and characteristically ulcerated on its surface the disease too often has already invaded the lymphatics, and the most favourable time for operation has passed. Before the wart has become indurated and fixed at its base the only reliable means of diagnosis are the microscopical appearances, and the beneficial effect of cleanliness and treatment, or otherwise.

When the disease commences as a subcutaneous pea- or bean-sized nodule it ought to be diagnosed as malignant at once.

Between cancer and primary chancres, or the sores of late syphilis, the effect of a fortnight's treatment ought to settle the doubt. It should never be forgotten that an obstinate tertiary syphilitic sore on the penis, as on the tongue, leg, or elsewhere, is very prone to pass into an epitheliomatous growth. No time should be lost, therefore, in operating upon a doubtful ulcer that does not improve under specific treatment.

In all cases where an induration or a sore exists beneath a

phimotic prepuce, the prepuce should be slit up and examined ; or if the whole of the disease can be removed with the prepuce, circumcision should be performed.

Treatment.—In any case of doubtful wart or ulcer that has resisted the ordinary treatment of cleanliness and suitable local applications for a few days, and has persisted or returned after having been freely treated by acid nitrate of mercury, or fuming nitric acid, nothing remains to be done but the complete and wide removal of the diseased tissues.

The amount of penis to be removed depends entirely on the extent to which it is invaded. In some cases amputation may be safe just behind the glans or through the organ half way between the pubes and the glans ; or it may be required immediately in front of the pubes, or even still farther back, so that the whole of the erectile structures are taken away, including the crura penis and the bulb of the urethra.

If the inguinal glands are enlarged, they must be freely removed. But when these operations are undertaken, the surgeon must be prepared for extensive and complicated dissections exposing the saphena vein and femoral vessels and the anterior crural nerve.

LIII. INJURIES AND DISEASES OF THE FEMALE GENITAL ORGANS.

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Middlesex Hospital.*

THE female genital organs may, for descriptive convenience, be divided into the following parts—the vulva, including the perinæum and hymen; the vagina; the uterus; the Fallopian tubes; the ovaries; and the broad ligaments.

Before discussing the various injuries and diseases to which these parts are liable, it will be necessary to consider the methods usually employed in their physical examination.

Methods of examination.—The complete physical examination of the female genital organs requires to be conducted in a systematic manner. Such investigations involve—(1) an examination of the abdomen; (2) an exploration of the vagina; (3) an inspection of the vulva. (*See also page 660.*)

1. Abdominal examination.—Whenever it is possible the patient should be undressed; nothing is so unsatisfactory as examining an abdomen to ascertain or disprove the existence of a tumour when the hips and waist are encumbered by partially loosened skirts, stays, petticoats, and other garments. It is useful to advise the patient to have the rectum emptied by an enema some hours before the examination is to take place, and to empty the bladder shortly before the inspection actually begins. Neglect of these two simple measures has been a fertile source of inexcusable blunders in diagnosis.

The patient should lie on her back upon a bed or couch, with her legs slightly flexed and her head resting upon a pillow; the legs should be covered with a blanket or counterpane, and the room should be comfortably warm. The surgeon should be careful that his hands and finger-tips are warm, as cold fingers produce uncomfortable sensations when placed on the abdomen, and hinder a proper examination.

Inspection.—The practised eye quickly notes alterations in contour, the presence or absence of a linea nigra, or lineæ albicantes, signs of great value in indicating previous distensions of the belly.

Recent lineæ albicantes are glistening and pearly; old lineæ are dull white, like stars.

Palpation, which should be gently performed with both hands, quickly teaches whether swellings are hard or soft, tender or obtuse, mobile or fixed, regular or irregular, nodular or smooth, as well as conveying the sense of fluctuation, which indicates the existence of fluid, and often enables the surgeon to determine whether it be free or confined (encysted).

Percussion furnishes valuable evidence; by this means the surgeon determines whether a swelling is simply due to intestines distended with gas, or some more tangible material or fluid. Skilful percussion gives information of the extent of a swelling, and, in the case of fluid, whether it be free or encysted.

Auscultation is occasionally of service for differential diagnosis, especially when pregnancy, normal or abnormal, is suspected; it is also useful in other cases.

After carefully noting all that an examination of the abdomen furnishes, the surgeon proceeds to examine the patient by the vagina.

2. Vaginal examination.—Investigation of the pelvic organs by this method is inadmissible in the case of girls and unmarried females, unless there be good reasons.

In young women the condition of the pelvic organs can be ascertained by examining them through the rectum when the hymen is intact. Perhaps the most convenient, and certainly the most delicate method of conducting a vaginal examination on a conscious patient is to place her on the left side, with the legs flexed, and the hips well drawn over the side of the bed or couch, and covered with a sheet. The index finger of the right hand, anointed with vaseline or soap, is introduced into the vagina. The surgeon follows with his finger the fold of the buttock until he reaches the anterior edges of the perinæum. As the finger enters the vulva and passes into the vagina, information is acquired as to the character of the vulval orifice, the breadth or narrowness of the vagina, etc. The cervix is then sought, and its position and character determined. The finger then sweeps the vaginal fornices to ascertain the presence of any painful swelling, thickening, etc., and to notice their mobility, fixity, and relation to the uterus. In order to gain more accurate knowledge of the relation of swellings or tumours in the pelvis, the surgeon resorts to the *bimanual method*. The patient turns upon her back, and the index finger of the right hand is introduced into the vagina; the fingers of the left hand are placed upon the abdominal wall immediately above the pubes, and by steady pressure the various pelvic organs may be brought into contact with the finger in the vagina. The information furnished by this means is very valuable. The position and size of the uterus is readily determined, as well as its relation to surrounding structures. In many cases, especially in thin patients and those with lax abdominal walls, it is possible to raise the ovary out of the pelvis by means of a finger in

the vagina, and then examine it with the finger-tips of the left hand, pressing on the anterior abdominal wall.

It is universally admitted that the bimanual is the most satisfactory method of examining the pelvic organs of women.

In a large number of cases digital exploration furnishes sufficient evidence, but there are many in which more detailed information is required; then it is necessary to seek instrumental aid. Two very useful instruments are the vaginal speculum and the uterine sound.

The speculum.—There are many varieties of this instrument, but the two most useful are the duckbill (or Sim's) speculum and the tubular (or Fergusson's) speculum. It is unnecessary to describe these instruments, as they are best studied in the out-patient room and operating theatre, where they are always to be found. By means of a speculum, especially the duckbill, all parts of the vagina and cervix are actually exposed to view, and the presence and nature of diseased conditions recognised and their relations determined. In order thoroughly to expose the uterine cervix with a duckbill speculum, it is usually necessary to draw it into view with a volsellum. A speculum should be immersed in warm water before being introduced into the vagina.

The uterine sound.—This instrument is occasionally of service, as it enables the surgeon to determine the exact position of the uterus when it is displaced by tumours; and gives accurate information in regard to the size of the uterine cavity. It is, however, an instrument which requires skill and care in its employment, for many serious and evil consequences have resulted from incautious use of the sound. It is also quite certain that at times it has prevented the perpetration of serious errors in diagnosis. It is an instrument that should be used with great caution and judgment.

3. Inspection of the vulva.—When patients complain of trouble referable to the vulva only, and of such a nature as to render an inspection of the parts desirable, it is most completely carried out with the patient lying on her back, and the legs drawn up and separated. In this way the labia, fourchette, the vulval and urethral orifices may be thoroughly inspected when the parts are exposed in a good light.

Occasionally it is difficult to make a satisfactory examination of the pelvic organs in a conscious patient, sometimes on account of the physical pain it causes, and often because of the rigidity of the abdominal muscles, or narrowness of the vulval orifice, or the vagina. In such cases where it is necessary to make a careful examination then the patient may have the advantage of an anæsthetic.

THE VULVA.

The parts usually included under this term are sometimes called the external genitals, and comprise the labia majora and minora, the clitoris, the vestibule and fossa navicularia.

Injuries.—The labia are liable to lacerations, which may be due

to falls upon pointed objects, kicks from brutal husbands, and cuts from potsherds when chamber-pots break whilst women are sitting upon them. Lacerations are sometimes produced during labour and the careless use of midwifery forceps. Deep lacerations of the labia are usually followed by free bleeding, as the parts are very vascular.

Treatment.—Free the part from clots and secure the bleeding points with forceps and ligatures; capillary oozing is easily controlled by firm sponge pressure. The parts must be kept strictly clean.

Hæmatoma of the vulva.—As the tissues of the vulva are very lax and vascular, it is not uncommon for injuries to produce extravasation of blood, which may cause the greater labium to attain a large size. These subcutaneous hæmorrhages are rarely troublesome, and usually subside with rest and the application of cold lotions, or perhaps an ice-bag. In cases where the blood persists, it may be evacuated; or if suppuration be established, the treatment is that applicable to an abscess.

Inflammations.—The vulva consists of vascular folds of skin continuous with mucous membrane. The cutaneous covering is, in the adult, furnished with hair and sebaceous glands. Unless women keep themselves scrupulously clean, the secretion from the sebaceous glands lodges in the recesses of the vulva; discharges from the vagina, such as mucus and blood, accumulate on the parts, act as irritants, and favour the development of inflammatory conditions, which have received a variety of names. Thus the labia are liable to eczema, boils, inflamed sebaceous follicles, and acne; irritating discharges from the vagina will cause them to become inflamed, œdematous, and painful. Erysipelas may attack the vulva, and spread to surrounding parts. Parasites, commonly known as crablice, infest the hair on the pubes and labia; in children, and sometimes in women, *vulvitis* is often due to the irritation of thread-worms straying from the anus, and wriggling about the vulva.

Treatment.—In cases clearly depending upon dirt and the infrequent use of water, good results immediately follow strict cleanliness and the use of mild astringents, such as lead or alum lotions. In cases where a follicle inflames and forms an abscess, a timely puncture with a sharp narrow-pointed scalpel, followed by warm fomentations, or bathing in tepid water, quickly relieves the pain and initiates recovery.

Gangrene.—This is rare; it may follow protracted labour, or be a sequel of small pox, typhus fever, and the exanthemata.

Noma.—This term is applied to gangrenous inflammation of the vulva, which occasionally occurs in ill-fed and neglected children; in many cases it is a sequel of scarlet fever or measles. The disease appears as an inflamed spot on one of the labia, which quickly spreads, causing the vulva to become swollen, œdematous, painful, and dusky red; it is accompanied by great constitutional disturbance, fever, and in acute cases the soft tissues rapidly necrose and slough, the ulceration extending to the thighs and abdomen;

symptoms of septicæmia quickly manifest themselves, and the patient dies. (*See* p. 150, Vol. I.)

In mild cases, successful results have followed the destruction of the infected parts by means of the actual cautery, and supporting the patient with a liberal and suitable diet.

In cases which recover, cicatricial contraction and permanent occlusion of the vulval orifice are the usual consequences. Later in life it leads to sterility and hæmatokolpos.

Syphilis.—This disease may manifest itself on the vulva as a primary sore (chancre), or as mucous tubercles; tertiary manifestations (gummata) are infrequent. The opposed surfaces of the nymphæ, in the late stages of syphilis, sometimes present a white appearance like the changes on the mucous membrane of the tongue known as leucoplakia. The margins of these white surfaces are prone to ulcerate. In new-born girls of syphilitic parents the coppery-red spots, characteristic of congenital syphilis, are not infrequent on the labia. (*See* SYPHILIS, p. 420, Vol. I.)

Lupus.—This affection, introduced to the notice of British practitioners by Matthews Duncan, must not be confounded with the disease to which the name lupus is commonly applied.

The disease is extremely chronic, and characterised by enlargement of the labia and clitoris, the tissues of which are thickened, especially the skin and parts immediately subjacent; they are often enlarged, and resemble the condition known as elephantiasis. The thickened parts are exceedingly liable to ulcerate. In the most typical cases all parts of the vulva are attacked, but it may be confined to the labia majora or labia minora, and exceptionally it limits itself to the clitoris. The disease is painless, even when it has ulcerated; it does not affect the patient's health, or even lead to enlargement of the adjacent lymph glands. The disease is rare, and must not be confounded with epithelioma or syphilitic ulceration.

Treatment.—Free removal of the diseased parts with a scalpel, and cauterisation of the exposed surfaces. The administration of iron and arsenic internally is recommended.

Elephantiasis.—This disease, fairly common in tropical climates, is rare in Europe and North America. The change is due to obstruction of the lymphatics, which leads to excessive overgrowth of the connective tissue in the skin; this causes the parts to become excessively large, and the surfaces of the vulval structures present a peculiar tuberoso appearance. The greater labia are most frequently affected, but in the majority of cases the labia majora and minora, as well as the clitoris share in the general overgrowth.

The disease is most frequent during the period of sexual activity. Moderate enlargement of the parts does not cause much discomfort, but when the mass is heavy, it produces great distress. Many cases are known in which overgrown labia have formed pendent masses, reaching to the knees and weighing many pounds. (*See* p. 675, Vol. I.)

Treatment.—Free removal with the knife or thermo-cautery, or both methods combined.

Pruritus.—This is a symptom only, and is met with in diabetes, irritating vaginal discharges, eczema of the labia, threadworms when they wander from the anus to the vulva, parasites, etc. It is often complained of in elderly women, but on examination no cause is discoverable. The itching often comes on when the patients are in bed.

Treatment.—This consists in removing the cause whenever possible, and enjoining strict cleanliness and the employment of soothing lotions. In cases where no cause is obvious, very great relief may be afforded by the local application of cocaine, either as a lotion or an ointment. In many cases itching is allayed by keeping the labia separate from each other by means of strips of lint saturated with lead lotion, or even by anointing them with white vaseline.

Atrophy of the external genitals (*kraurosis vulvæ*).—In old age the labia majora atrophy so that the labia minora are no longer concealed. When the atrophy of the parts is excessive, it is sometimes termed *kraurosis* of the vulva.

Urethral caruncle.—This troublesome condition appears as a red vascular excrescence at the orifice of the urethra; it is usually sessile, but may be pedunculated. In size caruncles vary from a split-pea to a ripe cherry.

There is reason to believe that the starting-point of some, if not the majority of urethral caruncles, is the pair of small blind ducts found in the floor of the female urethra near its external orifice, and known as "Skene's tubes." These ducts are often the seat of troublesome inflammation, and it is a fact that the existence of caruncles is first detected by patients when they are the subjects of leucorrhœa, gonorrhœa, or some form of vaginal discharge. Occasionally the orifices of Skene's tubes may be actually demonstrated in the midst of a caruncle.

These excrescences are often exquisitely tender and cause pain, especially during micturition; when large they will lead to retention of urine. A caruncle occasionally produces vaginismus and pain during coitus. In some cases, however, they produce no symptoms.

Treatment.—The patient should be anæsthetised, and placed in the lithotomy position. The caruncle may then be destroyed with Paquelin's cautery, or dissected out.

In operating upon them, it is a good plan to search for the orifices of Skene's tubes, and if detectable, these ducts should be slit up, and the parts around destroyed with the cautery.

These caruncles are very apt to return unless freely treated; yet in excising them the surgeon must exercise care, for if he inflicts much damage on the urethra, incontinence of urine may ensue.

Tumours of the vulva.—The tumours to which the vulva is liable are lipomata, myxomata, sarcomata, epithelioma. With these must be included cysts and carcinoma of Bartholin's glands.

Lipomata.—These may arise in the fatty tissue of the mons veneris, or in the deep connective tissue of the labia, and some-

times form large tumours ; they are occasionally pedunculated. Care must be exercised not to confound a sessile lipoma with an omental hernia (epiplocele) occupying a labium.

Myxomata.—These usually assume the form of a pedunculated tumour covered with rugose pigmented skin hanging from one or other of the greater labia (Fig. 925).

Sarcomata.—A sarcoma of the vulva is a very rare tumour, and is usually a melanoma, and arises in the pigmented skin of the great labium.



Fig. 925.—Pedunculated Myxoma of the Labium Majus. (Natural size.)

Angeliomata. — Nevi are occasionally seen on the labia ; like such tumours on other cutaneous surfaces, they are invariably congenital, or appear during the first few weeks of life. They are easily and safely excised.

Epithelioma.—This affection may begin in any part of the vulva ; it is far more frequent on the labia than the clitoris. Like epithelioma in other parts of the body, it is rare before middle life, and the liability is greater in elderly individuals. The disease presents the characteristic features of epithelioma as seen in other situations, and quickly involves the inguinal lymph glands. The infiltrated tissues ulcerate and form foul, horribly foetid hollows, and as the disease progresses, the infected lymph glands and the primary

tumour conjoin, forming a continuous ulcerating surface. Death is due to exhaustion and distress, the result of frequent hæmorrhages, or the large vessels in the groin may be opened by ulceration, and a sudden profuse hæmorrhage terminates the case.

Treatment.—Free and early removal as soon as the disease is recognised. Extirpation, to afford good results, should be carried out, if possible, before the lymph glands are involved. Unfortunately, quick recurrence in the scar or lymph glands is the rule.

Affections of Bartholin's glands. — The ducts of these glands open in front of the fossa navicularis between the labia minora and the hymen. They are liable to inflame and become cystic, and, very exceptionally, are attacked by cancer. As is the case with other secreting glands, septic organisms find their way along the ducts of these glands and cause inflammatory changes in the acini.

and spreading to the capsule, cause a painful swelling to form in one or both labia. The swelling may be due to pent-up mucus or pus in the gland, and causes great pain, especially during micturition or walking; occasionally the inguinal lymph glands are enlarged.

It must be borne in mind that all localised inflammatory swellings of the vulva, however, are not due to these glands; many arise in the sebaceous glands, which are of very large size, especially in the lesser labia.

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As lacerations of the perinæum are the direct consequences of normal or assisted labour, it is the duty of the practitioner, as soon as delivery is completed, thoroughly to wash the parts, and bring them into apposition by means of deep sutures. These primary operations are, in a very large proportion of cases, perfectly successful; the torn surfaces often adjust themselves to each other very accurately. Should union fail, slight degrees of rupture are rarely sources of inconvenience, but in the severe cases, especially when the anal sphincter is torn, much distress is the consequence; not only is there a sense of weakness of the part and often incontinence of fæces, but prolapse of the rectal wall, the uterus, or part of the bladder commonly occurs, and there is in addition sexual disability, which adds to the misery of these patients.

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especially when the laceration of the hymen extends to and involves the vaginal wall. Fatal injuries have followed the introduction of foreign bodies into this passage in outrages by brutal men, or by pointed instruments introduced by women in self-attempts to procure abortion; or by insane women during fits of sexual frenzy.

Treatment.—This consists in the removal of the clots and deliberate search for the bleeding vessels, which should be compressed with forceps. Pressure applied direct to the lacerated surfaces by means of a hot sponge readily checks capillary oozing. Occasionally it is necessary to plug the vagina with strips of iodoform gauze. The subsequent treatment is that adopted for wounds in general.

Foreign bodies.—All the natural orifices of the body are liable to have foreign substances introduced in them; this is exceptionally true of the vagina, not only in young and inexperienced girls, but in adult women. Young girls from sheer curiosity will insert hair-pins, pencils, pebbles and the like into the vagina, whilst older girls introduce fragments of sponge or cotton wool, for the purpose of preventing conception from illicit connection. Extraordinary objects, such as pomade pots, cotton-reels or spools, candle extinguishers, and small indiarubber balls have been removed from the vagina of matrons. Odd things such as a pipe bowl, thimble, pieces of metal, etc., have been thrust into the vaginae of low drunken women when rioting with men. Such bodies have remained undetected during many weeks. Obstetric practitioners are responsible for pessaries of curious shapes and varying thicknesses, which, after introduction, have been forgotten and remained for years in the vagina, and at last are re-discovered when profuse discharges, faecal or vesico-vaginal fistulae have led women to consult surgeons; then the long-forgotten pessary comes to light, perhaps half destroyed or encrusted with phosphatic deposits. Most hospital museums contain a comical set of objects removed from this unnatural repository. On one occasion a woman was admitted into the cancer ward of the Middlesex Hospital with a certificate to the effect that she was suffering from "stone cancer." On examination the alleged cancer turned out to be a piece of brick.

It is useful to bear in mind that, when a healthy young woman is found to be suffering from a stinking vaginal discharge, it is exceedingly probable that she has a foreign body in this passage.

Vaginitis (kolpitis).—Acute inflammation of the vagina may follow a variety of causes. In young children it occurs occasionally as a sequel to the exanthemata. In adult women the most frequent cause is gonorrhœa; absence of cleanliness; the presence of foreign bodies, and the irritation of threadworms.

The patients complain of pain, discomfort, and usually of a profuse irritating discharge, frequent micturition and scalding pain during micturition.

On examination, the vaginal mucous membrane is red, injected (occasionally ulcerated patches are present), and very tender. The surface is covered with a muco-purulent discharge.

Treatment.—Rest in bed, saline aperients, total abstinence from alcohol, warm hip baths, and frequent douching with tepid water, or water lightly tinted with permanganate of potash. A weak solution of acetate of lead (1 gr. to the ounce of water) is very useful. It is sometimes of service to keep the vaginal walls separated by means of small cotton wool plugs steeped in glycerole of tannin and the like. Local treatment in these cases is always effective if it is thoroughly carried out.

Leucorrhœa.—This is a very vague term, and covers almost any muco-purulent discharge from the vagina, independent of its source. Often it is the residue of an acute gonorrhœal vaginitis, and is comparable to gleet in the male. Muco-purulent discharges from the vagina frequently accompany anæmia; often a chronic vaginitis accompanies catarrhal conditions of the mucous membrane of the cervical canal. Leucorrhœa is a frequent accompaniment of pregnancy. Fœtid discharges indicate cancer of vagina or uterus.

Treatment.—Extreme local cleanliness, attention to the bowels, gentle exercise, and abstinence from alcohol. The use of tonics, especially mild preparations of iron, or quinine and strychnine combined, usually improve the condition.

Leucorrhœa in children.—A muco-purulent discharge is not uncommon in little girls, especially those who are not kept strictly clean. The condition is important, as the discharge is not infrequently mistaken for gonorrhœa, and grave legal errors have been made in consequence. The disease may assume a very acute phase, and the inflammation extending to the vulva causes much distress, and leads anxious mothers to believe that the child has been raped. Occasionally vaginal discharges in children depend on tuberculosis of the uterus. It is often associated with thread-worms.

Treatment.—Absolute local cleanliness, attention to the bowels, and tonics, especially a combination of iron wine and cod-liver oil. When the local distress is great, the vulva may be dusted with oxide of zinc, or be anointed with boracic ointment, lanoline, etc.

Vaginismus.—This term is applied to painful reflex contractions of the muscles surrounding the orifice of the vagina when attempts are made to effect sexual congress. *Vaginismus* must be distinguished from *dyspareunia*, which signifies painful coitus. When vaginismus is pronounced, sexual conjugation is impossible. The muscles chiefly at fault are the levators of the anus.

Vaginismus may depend on irritable ulcers of the vulva, inflamed or incompletely ruptured hymen; irritable myrtiform caruncles, urethral caruncle, a narrow vaginal inlet, and occasionally piles will provoke painful spasm of the levators of the anus. In many cases no obvious cause exists.

Vaginismus is most marked in newly-married women; careful examination of the vulva and anus will often reveal some local lesion to which appropriate treatment should be directed. If the trouble can be relieved, so as to allow of complete conjugation and

pregnancy results, permanent cure is likely to follow, as the stretching of the vulval outlet, the necessary consequence of delivery, will often relieve the spasm. This method of cure may be initiated by administering an anæsthetic, and dilating the vulval orifice by the introduction of a speculum, or stretching the parts with the fingers. In recently married women, vaginismus is merely transitory, and often disappears if the functions of the parts are temperately indulged. In many cases the local application of cocaine mixed with vaseline (2 per cent.) is sufficient to diminish the sensitiveness, until extended use of the parts renders them accustomed to the male organ.

Tumours of the vagina. Cysts.—These are rare. The most interesting examples occur in the lower segment of the vagina, in relation with its anterior wall, and near the orifice of the urethra. The cyst is almost invariably single, and rarely exceeds a bantam's egg in size, and as it bulges into the vagina, often resembles a cystocele. When a sound is introduced into the bladder, the independence of the two structures is easily demonstrated. The interior of the cyst is lined with deep layers of stratified epithelium; and the contents are mucus. Many of these large epithelium-lined vaginal cysts arise in the persistent terminal segment of Gartner's duct. When large vaginal cysts burrow upwards between the layers of the broad ligaments. Exceptionally, a Gartnerian cyst occupies the broad ligament, and a second smaller cyst bulges into the vagina. These cysts occasionally inflame and suppurate.

Treatment.—They should be dissected out. In carrying out this measure the operator must keep close to the wall of the cyst, otherwise he runs the risk of wounding the bladder or the ureter. It is absolutely necessary to dissect out the whole of the cyst; measures short of this are useless.

Sarcomata.—Tumours of this genus are rare in the vagina; the round- and spindle-celled species have been observed also myo sarcomata.

Epithelioma.—This is rare, and may occur in any part of the vagina, but it is more liable to begin near the vulval junction, and on that portion reflected over the uterine cervix.

The tendency of epithelioma to arise at the vulvo-vaginal segment is analogous to what is observable at other muco-cutaneous junctions. In a fair proportion of cases it begins near the orifice of the urethra. The inguinal lymph glands are early infected. The disease infiltrates the vaginal wall, and ulceration will lead to the formation of a vesico-vaginal fistula. When the posterior vaginal wall is attacked, the recto-vaginal septum is implicated, and a recto-vaginal fistula is the result.

It is very remarkable that in its early stages epithelioma produces such slight inconvenience, that women rarely seek advice until the disease has long passed the limits of operative interference.

Epithelioma of that part of the vaginal mucous membrane

reflected over the uterine cervix will be dealt with in the section devoted to the uterus (page 1040).

It rarely happens that epithelioma of the vagina comes under observation at a sufficiently early stage to permit of successful operative treatment.

Vaginal fistulæ.—Placed as the vagina is between two hollow viscera, the bladder with the urethra anteriorly and the rectum posteriorly, it is not surprising that fistulous communications are frequent. A fistula between the bladder and vagina (vesico-vaginal) is more frequent than one between the rectum and vagina (recto-vaginal). These fistulæ are usually caused by sloughing of the vaginal wall, due to protracted and difficult labour. They sometimes follow lacerations and ulcerations due to foreign bodies—*e.g.* a pessary impacted in the vagina; and are frequent concomitants (in the late stages) of cancer and epithelioma of the vagina, rectum, bladder, or uterus.

Vesico-vaginal fistulæ are discussed in the section devoted to affections of the bladder. (See page 953.)

Recto-vaginal fistulæ are sources of much distress, as the patients are annoyed by the escape of fæces and fluid from the rectum into the vagina; the amount of distress varies with the size of the fistula, some barely admit the end of a probe, whilst others may accommodate the tip of a finger.

Small fistulæ will occasionally heal spontaneously; others require surgical intervention, the principle followed in closing these fistulæ consisting in placing the patient in the lithotomy position, and exposing the opening by means of a speculum. The edges are then pared with a sharp narrow knife, and the freshened edges carefully approximated with sutures. The greater the care expended on the preparation of the patient and in the suture of the wound, as well as in the subsequent management of the case, the more likely is it to be successful. When recto-vaginal fistula complicates rectal, vaginal, or uterine carcinoma, colotomy often affords great relief.

Hæmatokolpos.—This term is applied to distension of the vaginal canal with retained menstrual fluid. The retention depends on occlusion of the lower end of the vagina, which may be due to (1) imperforate hymen; (2) cicatricial union of the labia.

Hæmatokolpos is usually discovered by the mother of the patient becoming aware that the girl, though at the age when menstruation should declare itself, yet its most obvious manifestation—the periodical escape of blood from the vagina—is absent. Nevertheless, the girl suffers from recurring monthly abdominal pains and discomfort, accompanied by a gradual enlargement of the lower part of the abdomen; this leads to an investigation.

When the retention is due to an imperforate hymen, this membrane will be observed, on inspection, stretched across the vulval orifice; and sometimes it will present a convex contour, which bulges when pressure is made on the belly immediately above the symphysis.

In cases where obstruction is due to cicatricial occlusion of the vulval orifice, the consequence of burns in young children, or the effects of noma, the mothers are forewarned, and usually seek timely aid.

In cases where the hæmatokolpos forms a very large tumour, the fundus of the uterus is carried out of the pelvis, and is pushed forwards into contact with the anterior abdominal wall some distance above the pubes.

Hæmatokolpos is often associated with distension of the uterine cavity with menstrual fluid—*hæmatometra*. (See page 1034.)

Treatment.—Removal of the obstruction by free incision of the hymen, or division of the cicatrix when this is the cause, and thorough evacuation of the retained viscid, treacle-like fluid. Then thoroughly flush out the cavity with some reliable antiseptic agent, such as warm water containing perchloride of mercury (1 in 5,000). The cavity should be freely irrigated twice daily with warm water slightly tinged with permanganate of potash, and precautions taken to prevent the edges of the vagina from re-uniting.

The dilated cavity should be thoroughly emptied at the outset, and the parts kept clean and aseptic.

THE UTERUS.

The cervix.—The chief abnormal conditions of the uterine cervix with which it is necessary for surgeons to be familiar are—(1) conical cervix with a pin-hole os; (2) elongation of the cervix; and (3) laceration. In addition, there are certain inflammatory conditions of the mucous membrane lining its canal; and lastly, it is liable to be attacked by tumours.

(1) **Conical cervix.**—In this condition the cervix assumes a characteristic cone shape, and the external os is small and circular, instead of presenting a transverse slit. The condition is often associated with painful menstruation and sterility.

(2) **Elongation of the cervix.**—This is usually regarded as a developmental defect, and consists of an exaggerated lengthening of the cervical section of the uterus. The cervix often continues to lengthen, until the mouth of the uterus presents itself at the vulval orifice, and, in exceptional cases, may even protrude beyond the labia. In a severe case the patient's attention is drawn to the matter on account of the irritation produced by the protruding cervix; in some the elongated cervix ulcerates, or there is profuse leucorrhœa. When the enlargement is not excessive and does not pass beyond the region of the hymen, the condition is not discovered until the patient marries, then pain, difficulty in coitus, or sterility induces her to seek advice, and submit to an examination.

The diagnosis is not difficult, as on examination the surgeon will find that the vagina maintains its normal depth behind and in front of the cervix. The only condition likely to be confounded with it is prolapse of the uterus.

Treatment.—This consists in amputating a portion of the cervix. This may be carried out with the scalpel, or Paquelin's cautery. The operation is sometimes followed by severe hæmorrhage. A remote effect is stenosis of the canal, due to cicatrisation.

(3) **Laceration of the cervix.**—One of the commonest accidents incidental to parturition is a tear in the neck of the uterus. The laceration may involve only a small part of the cervical tissues, or it may extend to the vaginal fornix; occasionally it involves both sides of the cervix, and the two halves separate like the leaves of an open book—such laceration is described as bilateral.

In some cases the cervix is torn superficially in several directions, so that when they heal, the parts around the os present a puckered appearance, which is termed a stellate laceration.

The most important variety of laceration is the bilateral, because the separation of the two halves of the vaginal portion of the cervix exposes the mucous membrane lining the canal, and causes it to become tumid, and of a bright pink colour; it is frequently the source of a profuse semi-purulent discharge.

Lacerations of the cervix are produced by precipitate labours, the use of midwifery forceps, and artificial dilatation of the cervical canal by means of dilators.

The effects of a lacerated cervix are regarded by some practitioners as very serious, whilst by others they are treated with more or less indifference. Some women have very extensive lacerations, without experiencing the least inconvenience. Perhaps the most important ill effect associated with the condition is profuse leucorrhœa, and a few indefinite symptoms that accompany endometritis; it will, therefore, be more convenient to discuss the treatment in connection with this affection.

Endometritis.—The mucous membrane of the uterus, including that lining the cervical canal, is termed the endometrium; hence inflammation of the uterine mucous membrane is now termed endometritis. Inflammation or catarrh of that portion of the mucous membrane lining the cervical canal is known as *cervical endometritis*. It is an extremely common and troublesome affection.

Cervical endometritis is a frequent sequel of parturition, and is often associated with retroflexion of the uterus; lacerated cervix is a common complication. It is an occasional consequence of acute endometritis of the uterine cavity, and is sometimes due to extension upwards of a vaginitis. Certain it is that cervical endometritis is met with in unmarried women and in those who have not had children.

The *symptoms* are profuse leucorrhœa, pain in the loin, and often left sub-mammary pain. On examination, the cervix is found to be abnormally large, and the margins soft and velvety; frequently lacerations are detected, as well as small rounded shotty elevations, caused by distended glands. The os is usually patulous.

When the parts are examined through the speculum, the os is usually obscured by a plug of tenacious mucus; when this is removed

the mucous membrane will be seen to pout from the os, and is of a lively pink colour. This pink tissue is not limited to the margin of the os, but extends to the surrounding parts; and, in severe cases, the lower end of the cervix is expanded like a mushroom. When there is bilateral laceration, the separated halves of the cervix are in contact with the vaginal fornices, and its exposed surface is covered with soft, puffy, pink tissue, dotted here and there with spots of a brighter colour.

The pinkness of this tissue led former writers to regard this condition as ulceration, and chronic cervical endometritis is even now frequently described as "erosion." Careful histological inquiries show that it is due to overgrowth of the cervical mucous membrane, with a new formation of racemose glands, which extends for some distance beyond the os. Investigations further show that the disease is not limited to the neighbourhood of the os, but often extends the whole length of the cervical canal, and may even involve the endometrium of the uterine cavity. In severe cases the cervical endometrium increases irregularly in thickness, and pedunculated processes, consisting of clusters of glands set in delicate connective tissue, project into the cervical canal.

Treatment.—In mild cases the regular use of warm water irrigation or mild astringents serves to keep the leucorrhœa in check. In severe cases the most satisfactory measures consist in placing the patient in the lithotomy position, dilating the cervical canal up to No. 8 Hegar's dilator, and then thoroughly scraping away the overgrown cervical endometrium with a curette or a sharp spoon. The canal is then thoroughly irrigated with an antiseptic solution; any hæmorrhage is rapidly checked by irrigating with hot water (110° Fahr.). The parts are then kept clean by frequent douching during ten days. This method of treatment is more satisfactory than the daily application of acids and caustics to the cervical canal over periods of weeks or months. In cases of endometritis, complicated with bilateral laceration, thorough treatment with the scoop gives results quite as satisfactory as those obtained by the complicated procedure known as trachelorrhaphy. In some cases excellent results may be obtained by rendering the cervix anæsthetic with cocaine 5 per cent., and thoroughly applying a fine point of a Paquelin or a galvanic cautery to the pink adenomatous tissue.

Acute endometritis.—Acute inflammation of the uterine mucous membrane may be due to septic causes within the uterine cavity following labour, abortion, operations on the uterus, or the introduction of dirty instruments, such as sounds, dilators, or stem pessaries. Occasionally it is caused by extension of septic infection from the vagina.

The mucous membrane is of a pink colour, soft, swollen, and covered with a muco-purulent exudation. The acute stage is accompanied by fever, pain in the hypogastric region, and a profuse discharge. The infection is apt to involve the Fallopian tubes and cause acute salpingitis.

Treatment.—This consists in keeping the patient at rest in bed; the application of warm fomentations to the abdomen; measures should be taken to unload the rectum, either by enemata or purgatives. Great comfort is afforded by vaginal douches of warm water lightly tinted with permanganate of potash.

The sequelæ of acute endometritis.—The inflammation may completely resolve, but in many cases it is followed by changes that often lead to disastrous consequences. The disease may become chronic, and give rise to menorrhagia, metrorrhagia, or leucorrhœa, which produce anæmia and disturbance of health. An important consequence is sterility. The most serious complications of *acute* and *chronic endometritis* are due to extension of the infection to the Fallopian tubes.

Our knowledge of the pathological conditions of the mucous membrane lining the cavity of the uterus is very imperfect; this is due to the fact that endometritis is in itself rarely a cause of death. In fatal cases, death is almost invariably due to septic material from the uterine cavity travelling along the tubes, and directly infecting the peritoneum.

Twelve varieties of chronic endometritis have been described, but as these do not rest on a substantial pathological basis, it will serve no useful purpose to discuss them. Thus we find such names as *Diffuse hypertrophic endometritis*, or *E. fungosa, papillosa, polyposa, decidualis, exfoliativa, dissecans, atrophica, hæmorrhagica, dysmenorrhœica*, etc. There are great difficulties in the way of a clinical classification of chronic endometritis, as the uterine mucous membrane is not very accessible to visual means of exploration. Indeed, the mode adopted to frame a diagnosis in severe cases is sufficient to indicate this. It consists in dilating the cervical canal with Hegar's dilators, and detaching portions of the mucous membrane with a curette; fragments thus removed are submitted to microscopical examination, in order to determine their nature. The chief signs on which a diagnosis of chronic endometritis is based are often equally indicative of the retention of fragment of placenta or chorionic villi, of thickened chronically inflamed mucous membrane, or of uterine cancer.

It is important to remember that the last two conditions often so closely simulate each other that the diagnosis is extremely doubtful, and in several cases the uterus has been excised under the impression that the disease was cancer, when a subsequent microscopical investigation of the uterus has shown it to be chronic endometritis.

Treatment.—The best method of treating chronic endometritis consists in dilating the cervical canal with Hegar's dilators, then thoroughly curetting the mucous membrane, and irrigating the cavity with an antiseptic solution.

This mode of treatment is safe, provided the following conditions are observed:—The cervical canal should not be dilated beyond No. 16 Hegar's dilator; when there is evidence of pelvic cellulitis (recent or old), distended tubes, or inflamed ovaries; when endometritis

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coexists with pyosalpinx, dilatation of the cervical canal is a dangerous and highly reprehensible proceeding.

The pathology, diagnosis, and treatment of *salpingitis* will be discussed in the section devoted to the Fallopian tubes (page 1046).

Retention cysts of the uterus.—When, from any cause, the cervical canal is permanently obstructed, the secretions, inflammatory exudations, and (at certain periods of life) menstrual fluid are retained, and dilate the cavity of the uterus until it attains a formidable size. Retention cysts of the uterus are of three varieties, according to the nature of the retained fluid, and are expressed by the terms *hydrometra*, *pyometra*, and *hæmatometra*.

1. **Hydrometra.**—The commonest cause of this condition is cicatricial occlusion of the cervical canal or vagina, the result of injury during parturition. The secretion from the glands accumulates and distends the cavity of the uterus; coincident with this, the walls thicken, until at last the organ attains a large size, and may mimic pregnancy or a myoma.

2. **Pyometra.**—This is occasionally a sequel to hydrometra, in consequence of putrefactive organisms gaining access to its highly albuminous contents, and establishing suppuration with all its attendant evils. Pyometra is more frequent than hydrometra, and is an occasional complication of cancer of the cervix. Hydrometra and pyometra are frequent complications of bicorned uteri; both cornua may be affected, or the distension may be limited to one cornu.

3. **Hæmatometra.**—This is usually secondary to hæmatokolpos (see page 1029); but hæmatometra is sometimes caused by congenital stenosis of the vaginal segment of the cervical canal.

In well-marked cases of distension of the uterus, secondary to obstruction at the external os, the effects upon this organ are very striking, and are the reverse of the conditions observed when the uterus is gravid. In the latter condition the enlargement affects the body and fundus; whereas in hydrometra and hæmatometra the cervical canal is distended sometimes to a great size, and resembles a ball, on which the external os may be perceived as a small dimple, whilst careful examination of the iliac regions will lead to the detection of the fundus raised out of the pelvis by the dilated cervix, and pushed to one side or the other.

When the obstruction is at the internal os, then the uterine cavity enlarges and resembles the early stages of a gravid uterus, and the cervix will be found protruding as usual into the vagina.

The signs and treatment of hæmatometra are identical with those described under hæmatokolpos, except that the patient has a normal vagina. This will induce the practitioner to exercise greater caution in diagnosis, as the association of amenorrhœa with a slowly increasing swelling in the belly of a girl or young woman may lead to the suspicion of pregnancy.

Hydrometra and pyometra in adult females simulate uterine myomata, and are especially difficult of diagnosis when occurring in

one half of a bicorned uterus. An examination of the cervix through a speculum, and inability to pass a sound, will reveal the existence of an obstructed cervical canal, and furnish a clue to the probable nature of the enlargement.

Treatment.—This consists in re-opening the obstructed cervical canal, or, if it depends on occlusion of the vagina, the formation of a channel to allow the accumulated fluid to escape; this is followed by thorough irrigation of the cavity, and the adoption of precautions to prevent re-occlusion of the opening.

TUMOURS OF THE UTERUS.

The uterus is liable to the following genera of tumours: myomata, sarcomata, adenomata, and carcinoma.

Myomata.—The pathological features of uterine myomata are described in the section devoted to tumours (p. 462, Vol. I.), and that account should be re-read as a preliminary to their clinical characters.

In the following account no consideration will be given to the small pedunculated myomata of the uterine cavity, as they will be considered later under the name of polypi (page 1039).

Age.—Uterine myomata are the commonest tumours to which women are liable, but they are unknown before puberty, and rarely attract attention before the twenty-fifth year; from this age they increase in frequency, which attains its maximum between the thirty-fifth and forty-fifth year. Hard myomata usually cease to grow after the menopause; a few shrink somewhat at this period, but the majority remain *in statu quo*, and slowly calcify. Occasionally a soft myoma will grow very rapidly after the menopause.

These tumours are exceptionally prone to occur during the sexual period of a woman's life, and exercise in many instances a great influence on one of the chief signs of sexual maturity—namely, menstruation.

Symptoms.—In a very large proportion of cases, one of the earliest signs of a myoma in the uterus is excessive menstruation—or, as it is called, *menorrhagia*—and this may be accompanied by bleeding between the periods, or *metrorrhagia*. These hæmorrhages are often the only symptom that leads the patient to seek advice, and on examination a pelvic tumour is discovered. When the tumour is so large as to rise out of the pelvis, it usually occupies the middle of the belly, but pedunculated myomata will sometimes lie in the flanks, like ovarian tumours. To palpation they may be smooth; frequently they are tuberoso, which is a valuable sign. The tumour is dull on percussion, the dullness ceasing abruptly at the borders of the tumour. The flanks are resonant in all positions of the patient. Auscultation is sometimes valuable; rapidly-growing myomata will yield a loud venous hum, synchronous with the pulse. This sign may exist a few days before the onset of a menstrual period, and disappear as soon as the flow occurs.

On pelvic examination the tumour will be found to have close relations with the uterus. Frequently the cervix and body of the uterus form a rounded globular mass, occupying the whole available pelvic space, and in the place of a cervix, simply a dimple will be felt in the vaginal vault; this dimple represents the os uteri.

Sometimes the sound will be of great assistance; in most cases of myoma the cavity of the uterus is elongated. The sound may convey information of the position of the tumour—whether it grows from the fundus, front, or back of the uterus, or involves the whole organ. The sound is an instrument demanding extreme care in its use. It should be remembered that a myomatous uterus not infrequently becomes gravid. When free bleeding follows even the gentle use of the sound, it is often an indication that there is a submucous tumour projecting into the uterine cavity.

The chief conditions that complicate the diagnosis of large uterine myomata are pregnancy and ovarian tumours. It is, however, important to bear in mind, as mentioned above, that pregnancy and myomata may coexist; and not rarely ovarian tumours complicate uterine myomata.

In some cases the detection of uterine myomata is simple and certain; in other cases the wisest and most experienced find great difficulties in the way of exact diagnosis.

Complications.—There are two very important complications to which uterine myomata are liable—viz. *impaction* and *gangrene*.

Impaction.—A myoma is said to be impacted when it fits the true pelvis so tightly that the tumour cannot rise into the belly; indeed, it may be so firmly fixed in the true, that it cannot be pushed into the false pelvis (Fig. 926).

Temporary impaction occurs in very vascular myomata immediately before the onset of a menstrual period. Impaction, whether temporary or permanent, leads to baleful pressure on the bladder, ureters, urethra, rectum, or iliac veins. Very large tumours rest on the brim of the pelvis, and press upon the ureters and rectum as they dip into the true pelvis, and produce hydronephrosis and obstruction of the intestine.

Gangrene.—When a large submucous myoma protrudes into the vagina it may become infected and gangrenous, giving rise to the severe constitutional signs characteristic of septicæmia. Clinically a myoma in this condition is known as “a sloughing fibroid.”

The chief **causes of death** are:—

(1) *Hæmorrhage.*—Copious bleeding leads to death, directly or indirectly, nearly as frequently as post-partum hæmorrhage causes death directly. Often it causes death indirectly by producing extreme anæmia (Matthews Duncan).

(2) *Mechanical effects.*—Pressure on the rectum, leading to intestinal obstruction; pressure on the urethra, leading to retention of urine, cystitis, and septic nephritis; pressure on one or both ureters, hindering the flow of urine and inducing hydronephrosis, etc.

(3) *Pregnancy* in a uterus containing a myoma may terminate happily, but more often it leads to abortion, and seriously imperils the life of the mother. Exceptionally, when a uterine myoma and

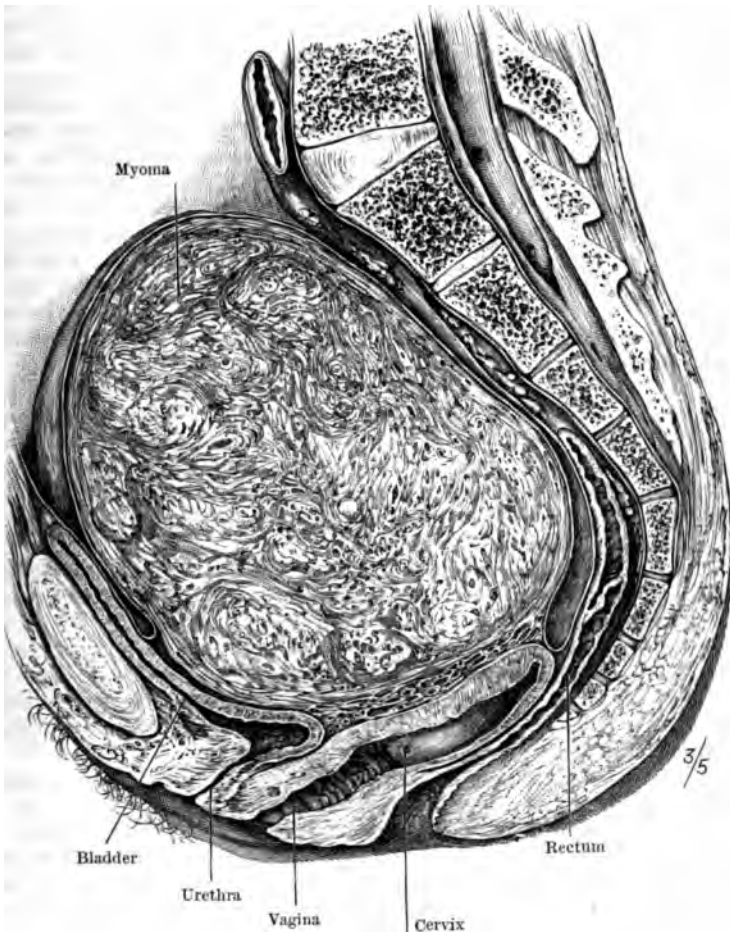


Fig. 926.—Frozen Section of a Pelvis containing an impacted Uterine Myoma.

pregnancy coexist, the myoma disappears with the involution of the uterus.

(4) *Peritonitis*.—When a pedunculated myoma becomes gangrenous, the uterine mucous membrane will sometimes necrose, and septic matter finds its way along the Fallopian tubes and fatally infects the peritoneum.

Treatment.—It is by no means easy to frame rules for the treatment of uterine myomata. If they could be removed with the same ease and safety as ovarian tumours, hysterectomy would be the proper course. The removal of a uterus containing a large myoma through an incision in the belly wall is a grave proceeding, but fortunately there is an alternative which is often as useful, and certainly far less formidable and dangerous. It has already been mentioned that many myomata cease to grow after the menopause, and many shrink greatly. Taking advantage of the fact, surgeons often anticipate the menopause by removing the ovaries and tubes (oöphorectomy). This method, however, is not applicable in all cases, for in many the tubes and ovaries are so implicated in the tumour that they cannot be removed completely; and if the least piece of ovarian tissue is left behind, menstruation continues and nullifies the operation. Many operations undertaken with the view of oöphorectomy have terminated in hysterectomy. For these reasons it is the rule not to interfere with uterine myomata unless they are directly threatening the patient's life. The practice usually adopted may be summarised thus :—

(1) A myoma is the cause of serious and repeated bleeding, producing profound anæmia; the bleeding is uninfluenced by rest and the administration of ergot. When these troubles are not due to a pedunculated myoma projecting into the uterine cavity, and the menopause cannot be reasonably expected for two or three years, oöphorectomy should be performed; failing this, hysterectomy if the anatomical conditions are favourable.

(2) A myoma of moderate size in a woman between thirty and forty-five becomes impacted, and causes retention of urine at each menstrual epoch.

Such a case is very suitable for oöphorectomy.

The following conditions demand hysterectomy :—

(1) A myoma rapidly increasing in size and extending high above the pelvic brim and pressing on the colon, so as to cause intestinal obstruction.

(2) A myoma rapidly enlarging after the menopause. Such tumours are rarities, but they are realities.

(3) A myoma that has given little trouble suddenly begins to enlarge rapidly, accompanied by rapid pulse, high temperature, and signs of septicæmia. These signs indicate septic infection of the tumour. A gangrenous myoma should be removed without delay: occasionally a gangrenous myoma is too large to be removed through the vagina, and requires abdominal hysterectomy.

It happens occasionally that an operator opens the belly, under the impression that he is dealing with an ovarian tumour. In such a case he should perform, if possible, oöphorectomy. The large pedunculated myomata, which simulate ovarian tumours, may be easily dealt with by transfixion and ligature of their pedicles.

Sarcomata.—The uterus is very rarely the seat of sarcomata, and in this respect is like striped and unstriped muscle in all regions

of the body. So rare, indeed, are these tumours in the uterus, and so few reliable descriptions are accessible, as to make it useless to attempt to write any useful general description of them.

There is an interesting species, which grows from the cervix, consisting of spindle-cells, and spindle-cells with transverse striation, mixed up with glandular structures derived from the mucous membrane of the cervical canal (myosarcomata).

Some cases have been described as sarcomatous degeneration of uterine myomata; in most of these the changes in the characters of the tumours were due to septic infection.

Deciduoma.—This is an extremely malignant species of tumour which makes its appearance usually at, or soon after labour at term, or abortion. (*See* p. 475, Vol. I.)

Adenomata.—Tumours, sessile and pedunculated, are not infrequently met with growing from the mucous membrane of the cervical canal, and less frequently from the endometrium of the uterine cavity. These tumours are often described as mucous polypi, but they are composed of a stroma of rich young connective tissue, in which glands are embedded. The type of the glands depends upon the situation of the tumour. The epithelium is very large and conspicuous, and the acini are often distended with mucus. Adenomata rarely exceed the dimensions of a ripe gooseberry; in most cases they are very much smaller than this.

Polypi.—The term polypus simply means a tumour furnished with a stalk, growing from the walls, and projecting into the cavity of the uterus, the cervical canal, or vagina.

A uterine polypus may be an adenoma, a myoma, or a myxoma. In size they vary greatly; adenomata and myxomata rarely exceed a gooseberry in size; stalked myomata are sometimes as big as a fist.

The presence of a polypus or polypi, for they are occasionally multiple, may be suspected when women complain of irregular hæmorrhages, followed by leucorrhœa. Occasionally the existence of a polypus is never suspected until the patient is annoyed by it protruding at the vulva; often leucorrhœa is the troublesome symptom, and an examination leads to the detection of a polypus.

When these tumours grow from the walls of the cervical canal or from the uterus, and project at the os, there is no difficulty in recognising them (*Fig. 927*); it is, however, important to bear in mind that a large intra-mural myoma may distort the uterine cavity, and appearing at the mouth of the uterus, resemble a polypus. In cases where a polypus occupies the uterine cavity, but does not extend low enough to protrude at the external os, its existence can often be suspected, and with such good reason as to warrant the practitioner adopting rigorous measures for its removal. It is important to remember that a submucous sessile myoma may invert the fundus of the uterus, and an inverted uterine fundus sometimes simulates a submucous myoma. Retained and firmly adherent fragments of placenta sometimes give rise to symptoms that simulate very

closely a submucous polypus. The fact that the trouble followed labour or abortion often furnishes the means of diagnosis.

Treatment.—When the polypus presents at the external os, it is easily detached by seizing it with a pair of forceps, and twisting it off. When the stalk is thick, it is occasionally advisable to ligature the pedicle. When the presence of a polypus is conjectural, it is necessary to dilate the cervical canal with Hegar's dilators, and having determined the existence and position of the polypus, remove it with forceps. In some examples of submucous myoma the bases are very broad, and demand great prudence and care on the part of the operator.

Epithelioma.—This disease begins in the mucous membrane covering the vaginal surface of the cervix, and may begin in any



Fig. 927.—Polypi growing from the Mucous Membrane of the Cervical Canal. (Nat. size.)

part of this surface, from the margin of the external os to the vaginal fornix. This is the only part of the uterus liable to epithelioma. Anatomically, the mucous membrane covering the vaginal surface of the neck of the uterus belongs to the vagina. It is, however, clinically convenient to consider it here.

In the earliest stages at which it comes under observation, the disease may assume the form of a circular ulcer with raised and everted edges, such as seen in many epitheliomata of the lips; sometimes it

erodes deeply from the beginning; exceptionally it forms luxuriant cauliflower excrescences (warty form). Thus in its naked-eye characters, as well as in its minute structure, epithelioma of the vaginal portion of the uterine neck does not differ from this disease in other regions of the body. Gradually the ulceration extends from the cervix to the vaginal wall; it rarely invades the cervical canal, but it quickly involves the connective tissue of one or both broad ligaments. The structures implicated by the disease quickly ulcerate and necrose. When these destructive changes involve the anterior vaginal wall, the bladder is apt to be perforated, and a urinary fistula adds to the misery of the patient. In a similar way, when the disease invades the posterior wall of the vagina, the rectum may be perforated. In some cases, in the later stages, when the upper segment of the vagina is destroyed, the bladder and rectum may both communicate with the vagina, and form a foul ulcerating cavity.

Symptoms.—Epithelioma of the cervix is unusual before the age of thirty, and is most frequent between the thirty-fifth and fifty-fifth years. The symptoms to which it gives rise are hæmorrhage,

offensive vaginal discharge, and pain. Irregularities of menstruation do not attract much attention unless oft repeated, and muco-purulent discharges (leucorrhœa) is such a common concomitant of vaginal and uterine affections that many women offer no complaint unless the discharge is very profuse, blood-stained, or offensive. Pain is a very unreliable sign; some experience no pain during the course of the disease, many suffer greatly in the latter stages, whilst in others pain is prominent from the commencement.

Diagnosis.—This is most important in the early stages. When a woman over twenty-five years, especially if she has borne children, complains of irregular hæmorrhage, offensive discharge, and pain, a vaginal examination is imperative. If the disease is in an early stage, the finger detects on some part of the cervix a hard ulcer with everted edges, or an eroded surface, which bleeds easily, or an irregular warty growth. If the disease is far advanced, a hard nodular mass will be detected, involving not only the cervix, but extending into one or both vaginal fornices. There is little difficulty in appreciating the disease during its late stages.

When the patient comes under observation early, the disease may be so localised that it will be necessary to pass a speculum and ascertain its precise position and limits. In advanced stages of epithelioma the passage of a speculum, even in experienced hands, is liable to be accompanied with profuse bleeding.

Treatment.—In the early stage, prompt removal of the cervix will do much to delay the progress of the disease. Operative interference has, however, a very limited application, because it can only be carried out when the disease is very restricted, on account of the close proximity of the bladder to the anterior surface of the cervix.

Recurrence usually begins at the cut edge of the vaginal mucous membrane, and spreads into the fornices. Thus supra-vaginal amputation of the cervix for epithelioma is as effective as removal of the entire uterus. Amputation of the cervix for an epithelioma in its early stage is attended with very slight risk to life.

Cancer of the uterus.—It will be necessary to consider this disease in two sub-sections: (1) cancer of the cervical mucous membrane; (2) cancer of the uterine mucous membrane.

1. **Cancer of the cervix.**—This is, unfortunately, extremely common; it may begin in any part of the cervical canal, but appears to be more common in the lower than the upper half (Fig. 928). The



Fig. 928.—Uterus in Section, showing Cancer of the Cervix in its early stage. (Natural size.)

disease begins in the mucous glands ; an caricature of the glands of the cervical canal and infiltrates the connective tissue of the vesico-vaginal and recto-vaginal septa. involves the vaginal portion of the cervix lower part of the body of the uterus ; and



Fig. 929.—Pelvis and its Viscera in Section. From a case which invaded the Bladder.

disease this organ becomes completely hollow until nothing but a thin layer of muscle toneum, remains. As in carcinoma in general glands are quickly implicated—first those of the internal iliac artery, and then the lumbar glands.

Dissemination is frequent ; secondary deposits are met with in the lungs. Deposits are met with in the same frequency as in mammary cancer.

Cancer of the cervical canal, like epithelioma of the vaginal portion, leads to perforation of the anterior

septa, so that urinary and fæcal fistulæ complicate the later stages of the disease (Fig. 929).

When the broad ligaments are extensively infiltrated, the ureters become involved ; this leads to dilatation of the renal pelves. As cystitis is a common complication of carcinoma of the cervix, this, in conjunction with the interference with the ureters, serves to explain the almost constant presence of suppurative pyelitis and nephritis found during *post-mortem* examination of women with uterine cancer. A very large proportion of these patients exhibit marked uræmic symptoms in the later stages of their lives.

Among other complications of cancer of the cervix, especially when it extends to the body of the uterus, must be mentioned pyosalpinx and hydrosalpinx. In these cases the dilated tubes are rarely thicker than the thumb, but they are a source of danger, inasmuch as perforation occasionally occurs, and sets up infective peritonitis. Exceptionally, the cancer perforates the body of the uterus. When this happens, peritonitis may ensue, and quickly cause death ; in some instances the carcinomatous material becomes distributed over the peritoneum, and small knots form upon the serous surfaces of the intestine, liver, spleen, etc. This distribution of the cancer may lead to an effusion of blood-stained fluid into the belly, sometimes in considerable quantity, or to agglutination of coils of intestine, each cancerous nodule being the focus of a limited area of peritonitis. Occasionally the transverse colon, or sigmoid loop, or the ileum not only adhere to the uterus, but a fistula is formed. It is important to bear this in mind, because when a fæcal fistula complicates the later stages of uterine cancer, it is usually attributed to communication with the rectum ; this is, of course, a very frequent, but not the only situation.

Symptoms.—Cancer of the cervix is common between forty and fifty ; many cases occur between thirty and forty ; between twenty-three and thirty it is unusual. This disease, like uterine myoma, is almost peculiar to the sexual period of female life, and it is much more frequent in multiparæ than in sterile women.

The signs of cancer are hæmorrhage, offensive discharge, and pain. The first two are the most usual signs, and lead to examination. In the early stages the condition of the os closely resembles cervical endometritis, but the hardness of the edges and the presence of a blood-stained discharge are suspicious signs.

On introducing the speculum, the edges of the os will be found everted, and fungous processes will be seen protruding from the canal, which readily break down and bleed on the slightest touch.

The conditions which are sometimes mistaken for cancer in its early stage are cervical endometritis, and inflammatory induration of the cervix, syphilitic ulceration, or a small sloughing polypus or myoma.

It is very rarely that the diagnosis gives rise to difficulty.

In the late stages of the disease, when the cancer has infiltrated and destroyed the cervix, and protrudes as a foul ulcerating

discharging growth, there is never any difficulty in appreciating its nature.

Treatment.—When the disease is detected early, before it has had time to overrun the cervix and implicate the vagina, or infiltrate the connective tissue surrounding the supra-vaginal section of the cervix, high amputation of the cervix may be carried out with good prospect of prolonging life. When there is reason to believe that the disease has extended beyond the internal os, then the whole uterus should be extirpated by the vaginal method.

2. Cancer of the body of the uterus.—This is a somewhat rare disease, especially when compared with the frequency of cancer of the cervix.

Histologically, it mimics the peculiar tubular glands that exist in the mucous membrane lining the uterine cavity. Very few cases of this affection have been described, because when the patients come under observation, the disease is usually regarded as some form of endometritis, and treated by scraping and the like.

Of the early stages of cancer affecting the body of the uterus nothing is known. The disease remains for a long time restricted to the cavity of the uterus, and occasionally creeps into one or both Fallopian tubes; but it very rarely involves the mucous



Fig. 930.—Uterus and Bladder in Section. From a case of cancer of the body of the uterus in its late stage.

membrane of the cervical canal, save in the very late stages, and after it has extensively destroyed the muscular substance of the uterus (Fig. 930). It is also apt to perforate the uterine wall, and lead to adhesion between it and the intestine.

Symptoms.—Cancer of the body of the uterus is rare before the forty-fifth year; it is most frequent at or subsequent to the menopause; most cases occur between the fiftieth and the seventieth years, and the patients are nearly always nulliparæ.

The signs that usually attract attention are the occurrence of fitful hæmorrhages after the menopause, followed by profuse and offensive discharges, which are often blood-stained. On examination the cervix feels and may appear normal when examined with the help of a speculum, but the uterus is often obviously enlarged.

The only method that will clear the diagnosis consists in

dilating the cervical canal, and then, by means of a curette, scraping the interior of the uterine cavity. Fragments of the mucous membrane are then submitted to microscopical examination. The disease with which it is apt to be confounded is chronic endometritis.

Treatment.—When the cervical canal is dilated for diagnostic purposes, the mucous membrane should be scraped, for if the disease should prove to be simply some variety of endometritis, the curetting will be beneficial; even if it should be cancer, this manner of treatment is often useful in checking bleeding for a time.

In some instances it will be clear, on examining the uterus after dilating the cervical canal, that the disease is cancer, and if the operator is satisfied, from the mobility of the uterus, that there is no implication of surrounding tissues, he will do well, if he has the consent of the patient, to remove the uterus.

General remarks on the operative treatment of cancer.—A study of the pathological tendencies of uterine cancer is of the first importance as a prelude to its treatment, because it would certainly be inferred, from experience acquired in the treatment of mammary cancer, that if it be desirable to remove a cancerous uterine cervix, the interests of the patient would be best served by the entire removal of the uterus.

The tendency of cancer of the cervix in its early stages is to infiltrate the parametric tissue rather than extend upwards and invade the body of the uterus. Cases are occasionally observed in which the disease, even in its early stages, involves the body of the uterus, but these are exceptional.

The great difficulty in the operative treatment of uterine cancer lies in the circumstance that the disease is so insidious, and, in the majority of patients, has involved the tissues so extensively before they come under observation, that an operation for the adequate removal of the disease is attended with so much immediate danger, and the probability of prolonging life so very remote, that few surgeons are disposed to urge such measures upon their patients.

The important question to decide in the treatment of cancer involving the cervical canal is this:—*When the disease is recognised early, and whilst still limited to the cervix, is it sufficient to amputate the cervix only, or should the whole uterus be extirpated?*

A careful study of the matter indicates that when it is possible to remove the disease completely by limiting the operation to the cervix, it is the safer measure, and offers a good prospect and minimum risk to the patient.

The rules for the treatment of uterine cancer may be formulated thus:—

(1) Amputation of the vaginal segment is sufficient when the disease is limited to the lower portion of the cervix.

(2) When the cancer has extended to the upper segment of the cervical canal it will be necessary to perform supra-vaginal amputation of the cervix.

(3) In primary cancer of the body of the uterus the whole organ should be removed through the vagina.

(4) When cancerous ulceration has extended beyond the uterine tissues, operative interference is worse than useless.

Palliative treatment.—It must not be imagined that when uterine cancer is beyond reach of operative measures, little can be done for the patient. Certain it is that surgery is unable to prolong life, but much can be done to mitigate the misery of the sufferer. Careful nurses should keep the patient clean by frequent douches, lightly tinged with permanganate of potash; these douches are painless, leave no odour of drugs, and do not cause irritation. When the odour is unusually offensive, a daily douche of perchloride of mercury (1 to 5,000), in addition to the usual irrigation, rarely fails to correct it.

Pain is alleviated by the judicious use of morphia subcutaneously administered, and the constipating effects of this drug are best met by variations in diet, accompanied by ripe fruits and suitable vegetables, aided by occasional enemata containing two drachms of turpentine, half an ounce of castor oil, a small piece of soap, and a pint of warm water.

The duration of the disease.—In inoperative cases life is rarely prolonged beyond a year and a half. Many die within a few months from the time they come under observation.

THE FALLOPIAN TUBES.

The chief affections of these structures may be considered under the following headings: (1) salpingocele; (2) salpingitis; (3) tumours; and (4) tubal pregnancy.



Fig. 931.—Salpingocele. (Modified from Lézars.)

1. **Salpingocele.**—This term is applied to the condition in which the fimbriated end of a Fallopian tube occupies a hernial sac in the femoral or inguinal regions unaccompanied by ovary, omentum, or bowel (Fig. 931). The condition is rare. The tube may be nipped or twisted so as to simulate a strangulated enterocele or epiplocele.

Cases in which the tube occupies a hernial sac with bowel or omentum, though

less rare, are by no means common.

2. **Salpingitis.**—Inflammation of the Fallopian tubes is in

nearly all cases secondary to septic infection of the genital tract. The chief causes are septic endometritis, gonorrhœa, and cancer of the uterus; the changes in the tubes induced by endometritis and gonorrhœa are almost identical. The effects produced may be studied in four stages:—

- (a) The acute stage, ending with closure of the abdominal ostium.
- (b) The mode by which the tube is closed.
- (c) Pyosalpinx.
- (d) Hydrosalpinx.

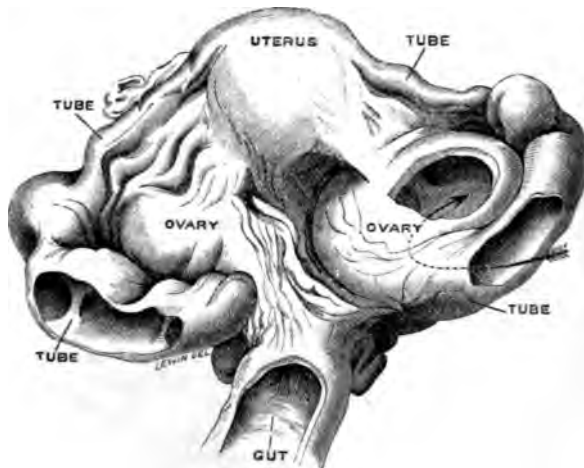


Fig. 932.—Pyosalpinx and Tubo-ovarian Abscess. (Museum, Royal College of Surgeons.)

(a) **The acute stage.**—When the inflammation extends from the vagina into the uterus, and extends thence to the tubes, the tubal tissues become soft, succulent, swollen, and friable. When the tube is slit up, its mucous membrane will be found covered with glutinous pus; or, on gently squeezing the tube, pus will ooze from the ostium. In some cases septic matter escapes into the pelvis, and fatal peritonitis results. When this occurs as a consequence of septic endometritis, following labour or abortion, the disease is termed “puerperal peritonitis.”

(b) **Occlusion of the ostium.**—This is a process of great importance, and it is brought about in two ways:—When inflammation extends from the tubal mucous membrane to the peritoneum adjacent to the ostium, it leads to the formation of adhesions, in consequence of the organisation of inflammatory products. Thus the fimbriæ adhere together, to the ovary, and adjacent parts of the broad ligaments. In this way the ostium is mechanically sealed. It is customary to speak of this as “perimetritic” occlusion of the ostium.

The second mode, or "salpingitic" occlusion of the ostium, is a slower and more perfect process. The Fallopian fimbriæ may be regarded as luxuriant protrusions of the mucous membrane beyond the ostium. When inflamed they enlarge greatly; as the inflammation extends to the muscular coat of the tube it becomes lengthened, and gradually bulges over the fimbriæ, until the ostium presents a rounded orifice instead of its usual fringed appearance. Eventually these rounded margins contract and cohere, giving it a smooth, rounded end (Fig. 932). Many tubes are occluded by a combination of perimetritis and salpingitis.

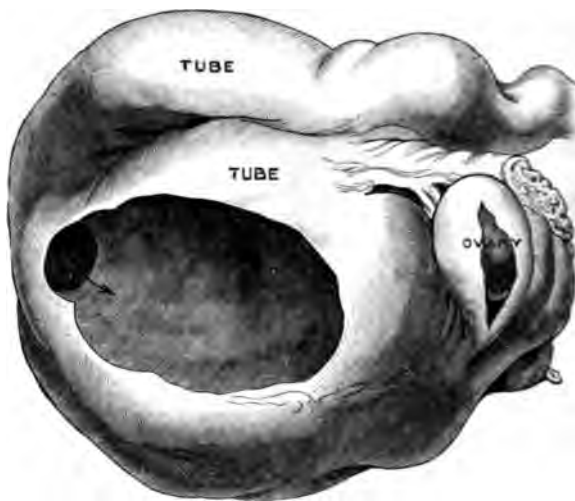


Fig. 933.—Hydrosalpinx. (Natural size.)

After closure of the ostium, pus or mucus accumulates within the tube, and converts it into a pyosalpinx or a hydrosalpinx. Should hæmorrhage take place into the distended tube, it becomes a hæmatosalpinx. In many cases no distension occurs, but the tubal walls become sclerosed.

(c) **Pyosalpinx.**—In severe cases of salpingitis after occlusion of the abdominal ostium, the pus is as securely locked up in the tube as it would be in a deep-seated abscess, and it follows the course of an abscess. The walls of the tube, stretched by the accumulating pus, gradually thin and become adherent to adjacent viscera, such as the ovary, intestine, rectum, uterus, or broad ligament. The wall of the tube will thin until, on some slight exertion, it breaks.

Should the pus be discharged into the peritoneal cavity, fatal peritonitis results. Left pyosalpinx is prone to open into the rectum.

Frequently the ovary becomes infected from the tube; under these conditions, whilst an occluded tube is slowly changing into a pyosalpinx, an abscess is forming in the ovary. In many cases they retain their distinctness; often the distended tube and the abscess in the ovary fuse and form a tubo-ovarian abscess.

d) Hydrosalpinx.—It must not be imagined that all cases of salpingitis end in occlusion of the tube and pyosalpinx. Many mild cases may be conveniently described as “catarrh of the tube,” which, like a nasal or gastric catarrh, subsides and leaves no trace. In others inflammation may lead to closure of the tube, and then subside; an occluded tube may then become passively distended with mucoid fluid, and converted into a hydrosalpinx (Fig. 933). A careful study of these conditions indicates that in many cases hydrosalpinx is a stage of pyosalpinx.

Hæmatosalpinx.—When old blood becomes effused into the cavity of a pyosalpinx, or hydrosalpinx, the condition is then described as hæmatosalpinx. Care must be taken not to confound a hæmatosalpinx with a gravid

uterus. It will be useful to define the terms applied to distended tubes resulting from salpin-

Pyosalpinx.—An occluded tube distended with pus or purulent fluid.

Hydrosalpinx.—An occluded tube distended with fluid, which is not bloody or purulent. **Tubo-ovarian abscess.**—A pyosalpinx communicating with an abscess in the ovary.

Hæmatosalpinx.—A non-gravid, Fallopian tube, with occluded lumen, distended with blood.

Sclerosis of the tube.—In many cases the abdominal ostium of the tube may become closed, and the subsequent changes may not produce either pyosalpinx or hydrosalpinx. The inflammatory exudate, instead of resolving, organises into fibrous or cicatricial tissue, and the tube becomes gradually converted into a hard cord. Sclerosed Fallopian tubes have a characteristic shape (Fig. 934). They are shorter than normal, and the outer end is often irregularly shaped, not unlike the crown of a pear. The tube itself is firmly fixed to the posterior layer of the broad ligament. Sclerosis of the tube is a very late stage of salpingitis; it is probable that it requires many months or even years for a tube to become sclerosed.

Tuberculous salpingitis.—Most examples of this disease are undoubtedly secondary to tuberculosis of the endometrium.

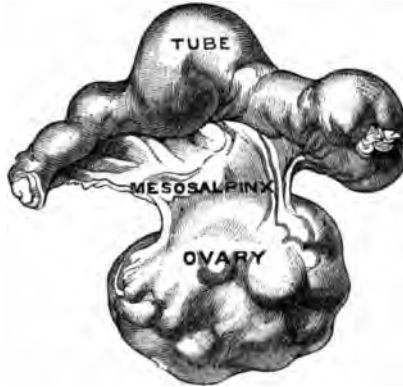


Fig. 934.—Sclerosed Fallopian Tube.

The naked-eye features of a tuberculous tube are often very characteristic, but frequently it is impossible to distinguish between it and a pyosalpinx. In many instances the abdominal ostium is occluded, and the tube tightly stuffed with caseous material. On removing this material, the mucous membrane presents the usual velvet-like appearance, characteristic of the walls of a chronic abscess.

In many patients tuberculous lesions are found in other parts of the body, so that it is difficult to decide the primary seat of the disease. The bacilli are often difficult of detection; however, when tubes are found distended with caseous pus, and lesions containing tubercle bacilli are found in other organs, it may be used as evidence that the disease in the tubes is likewise tuberculous. The only absolute test of tuberculous salpingitis is the detection of the tubercle-bacilli in the tubes.

It is an important clinical fact that many cases of tuberculous peritonitis in girls and young women are due to infection from tuberculous tubes, in which the ostium has remained open. Exceptionally, infection of the peritoneum has resulted from rupture of a tuberculous tube. On the other hand, it is possible that the tubes have in some cases become infected secondarily to tuberculosis of the peritoneum.

Symptoms.—The leading signs of acute salpingitis are not dependent on the tube itself, but become manifest when the inflammation extends to the peritoneum in the vicinity of the abdominal ostium.

In salpingitis secondary to septic endometritis the signs often come on with great suddenness. The discharges from the uterus are offensive, and the patient may have a temperature of 100° Fahr. Suddenly she is seized with a rigor, the temperature rises to 103° or 104°, the belly quickly swells, and in twenty-four hours there is clear evidence of infective peritonitis. In some of these cases death follows in a few days; in others the patients slowly recover. When these signs supervene on labour or abortion, the illness is often termed "puerperal peritonitis."

As a rule, slow accession of symptoms indicates gradual extension from mucous and muscular to serous tissue. Sudden onset of the severe signs means actual leakage from the tube into the peritoneal cavity. In some cases acute infection of the peritoneum is indicated by profound collapse. The above signs may be interpreted thus: slow extension leads to chronic changes; leakage, as a rule, leads to general infective peritonitis, and not infrequently to death.

Chronic salpingitis.—This is a very common disease, and one that sometimes imperils life; even in cases where life is not endangered, the pain and inconvenience these women suffer are often such as to render them chronic invalids.

The chief points are these:—The patient is usually between twenty and thirty-five years of age, and furnishes a history of

difficult labour or abortion, followed by a protracted illness, since which she has been sterile, has suffered from excessive, prolonged, and often painful menstruation. Defæcation and sexual congress are sources of pain; some complain also of a vaginal discharge. Single, and occasionally married women, furnish details of such a kind as lead us to believe that an attack of gonorrhœa marked the beginning of the trouble.

The *signs*, briefly summarised, are menorrhagia, pain, and sterility.

Tuberculous salpingitis has wider age limits, as it occurs in children from eighteen months onwards. In girls after puberty this variety of salpingitis is often accompanied by amenorrhœa.

On examining the abdomen, an irregular tender swelling may be sometimes detected in one or both flanks; more frequently there is an indefinite swelling, and in some, on palpation, a sense of resistance can be made out, but in very many cases no swelling can be detected by palpation of the abdomen.

On internal examination there will be found lying on each side of, or behind, the uterus an elongated swelling, which usually gives rise to great pain when pressed by the examining finger. Not infrequently the uterus is acutely retroflexed, and then the uterine fundus, with the enlarged tubes and ovaries, form a rounded ridge, running transversely across the pelvic floor.

As a rule, a moderately distended tube can only be felt through the vagina, or by the bimanual method.

Unfortunately, the signs of chronic salpingitis are simulated by many morbid conditions, so that positive diagnosis is impossible. The differential diagnosis will be discussed on page 1083.

Treatment.—As it is clear that salpingitis is such a frequent sequel of septic endometritis and gonorrhœa, increased attention is devoted to antiseptics by those who practise midwifery, in order to avoid septic infection of the uterus. In the case of gonorrhœa, more effective measures are adopted for its cure in the female.

In acute salpingitis leading to peritoneal infection, the treatment consists in keeping the patient resting in bed; warm antiseptic vaginal douches should be employed thrice daily, and the bowels should be kept free by means of gentle saline purges. If the pain is excessive, warm fomentations should be applied to the hypogastrium, and opium or morphia may be judiciously administered, so as to procure relief from pain.

When the mucous membrane of the tubes is seriously damaged, and the tubes are occluded and fixed to surrounding structures, drugs are of little use. When patients are in good circumstances and able to lead idle lives, they often become chronic invalids. In women who perform household duties, or who must of necessity obtain their own living, a life of luxury and ease is out of the question.

The ordinary rules of surgery suggest that when the physical signs and history of a case indicate that the tubes are occluded and distended with pus or other fluid, and produce pain and

suffering, so as to cause a woman to become a chronic invalid, then it is justifiable to remove them (oöphorectomy). The whole difficulty in the treatment of these cases lies in the doubt surrounding the diagnosis.

Removal of the Fallopian tubes and the ovaries is necessary in the following conditions :—

- (1) Pyosalpinx and tubo-ovarian abscess.
- (2) Hydrosalpinx.

In tuberculous salpingitis the operation should not be undertaken if there is evidence of tubercle in other organs.

The records of operations for pyosalpinx and allied forms of tubal disease show that they are attended with a higher rate of mortality than ovariectomy, and convalescence is, as a rule, prolonged.

A conservative measure, termed *salpingostomy*, is as yet in its infancy.

Non-inflammatory stenosis of the tubal ostium.—

There is a curious and somewhat rare variety of tubal distension, which is sometimes, though erroneously, described as pyosalpinx: it is not caused by septic changes in the uterus, or gonorrhœa. The patients are usually virgins, or if married, they are sterile.

In well-marked specimens the tubes become converted into huge banana-like or legume-shaped cysts, which not only appear above the pelvic brim, but sometimes reach as high as the navel.

The abdominal ostium is usually completely occluded, but traces of fimbriæ are present, even in extreme cases. The contents of these dilated tubes are like old honey, and occasionally of the consistence of soft wax. In some specimens the mucous membrane of the dilated tubes resembles chamois leather.

Distended tubes of this character rarely produce inconvenience until the enlarged tubes lead to obvious increase in size of the lower part of the belly.

The condition may depend on non-inflammatory stenosis of the abdominal ostium of the tubes, which is probably congenital. In the specimens that have yet come under my notice the disease was bilateral.

The removal of large tubes of this character is often a tedious process, as they require to be enucleated from the broad ligament.

3. **Tumours of the Fallopian tube.**—The Fallopian tube is very rarely attacked by tumours. It is liable to myomata, adenomata, and probably carcinoma.

Myomata.—Tumours composed of unstriped muscle tissue, growing from the Fallopian tube, are among the greatest rarities of oncology; this is extraordinary, considering the extreme frequency of myomata in the uterus. Even when growing from the tube they rarely attain such sizes as to be clinically important.

Adenomata.—Tumours composed of glandular tissue have on several occasions been observed growing from the tubal mucous membrane (Fig. 935). An adenoma of the Fallopian tube may assume the dendritic form of a large papilloma; or consist of a mass of cyst-like swellings, and resemble a bunch of grapes. The stroma of the

The tumour consists of delicate connective tissue, in which glandular acini, lined with a single layer of columnar epithelium, are embedded. Some of the cysts present in these tumours contain intra-cystic processes. A curious feature connected with these tumours is the presence of fluid in the belly—hydroperitoneum. This is due to the secretion from the adenoma escaping through the abdominal ostium of the tube, and irritating the peritoneum. Although the peritoneal fluid may be evacuated, it reaccumulates as long as the adenoma is allowed to remain. Removal of the adenoma at once and permanently arrests the effusion.

Cancer.—This disease as a primary affection is excessively rare. The tubes are occasionally implicated by extension of cancer from the uterus.



Fig. 935.—Adenoma of the Fallopian Tube. (After Doran.)

4. Tubal pregnancy.—Although great attention has been devoted of late years to the pathology of tubal pregnancy, no one has succeeded in detecting its cause. It may occur as a first pregnancy in women who have been married eight, ten, or even twenty years. It may follow a normal pregnancy or an abortion, within a few months; or occur as a first pregnancy in a woman of twenty or forty years, in the newly-married, or the mother of a large family. Both tubes may be gravid concurrently, or one tube may become pregnant years after its fellow. In very many cases tubal pregnancy occurs after long intervals of sterility.

A fertilised ovum (oöperm) may lodge in any part of the tube, and the course of events varies according to its position. Gestation in the outer two-thirds of the tube will be called tubal pregnancy; in the uterine segment, tubo-uterine pregnancy. The last variety will be considered separately.

The changes that follow arrest of an oöperm in the tube will be considered under the following headings:—

1. Changes in the tube.
2. The tubal mole.
3. Tubal abortion.
4. Tubal rupture.
5. The placenta and decidua.

Changes in the tube.—During the first few weeks that part of the tube in which the oöperm is lodged expands, and the walls, especially over the placental site, become very thin. The most remarkable changes occur in the vicinity of the abdominal ostium, for the muscular and serous walls swell and protrude beyond the fimbriae, then the edges gradually contract, and if the development of the embryo continues uninterrupted, the opening is completely occluded. It takes probably on an average eight weeks for this process to become completed. If the tube ruptures before the ostium is occluded, and the patient is fortunate enough to survive the accident, the process of occlusion is arrested. Careful observations upon a large number of gravid tubes serve to show that in some cases the ostium dilates instead of contracting, and specimens occasionally come to hand in which the ostium is represented by a

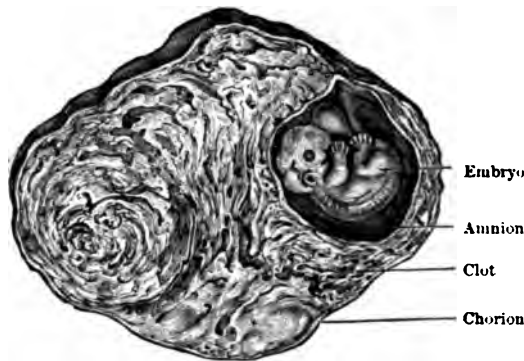


Fig. 936.—Tubal Mole in Section. (Natural size.)

circular opening 4 cm. in diameter. When the oöperm is retained near the abdominal ostium, its occlusion is more common than when it is lodged in the middle of the tube. When the oöperm is retained in the uterine section of the tube the abdominal ostium is unaffected.

The tubal mole.—After fertilisation the chorion becomes shaggy from the development of villi; these, as in the case of the uterine embryo, ultimately form a placenta. The life of an embryo, whether uterine or tubal, is always precarious until the formation of the placenta. The greatest danger that besets the oöperm is its liability to be converted into a tubal mole. Such a body is an early embryo and its membranes into which blood has been extravasated. Tubal moles vary greatly in size: some have been detected with a diameter of 1 cm.; others measure 5 or even 8 cm. Small tubal moles are globular; but after they attain a diameter of 3 cm. they assume an ovoid shape. The amniotic cavity usually occupies an eccentric position; occasionally the embryo is detected

within it. More often it escapes into the pelvic cavity in consequence of rupture of the chorion. When no embryo, amniotic cavity, or chorionic villi can be detected by the naked eye, a microscopic examination of sections will lead to the detection of chorionic villi. They are very characteristic structures, and as certain evidence of tubal pregnancy as the embryo itself.

The blood in a typical tubal mole is limited externally by the chorion, and is furnished by the blood-vessels of the embryo. In some specimens it is distinctly laminated.

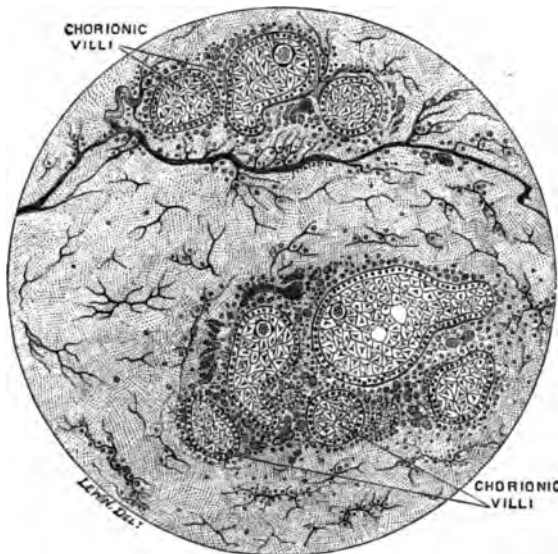


Fig. 937.—Microscopical Appearance of Chorionic Villi in transverse Section. From a tubal mole. ($\frac{1}{4}$ inch.)

Tubal abortion.—So long as the abdominal ostium of a gravid tube remains unclosed, the mole is in constant jeopardy of being extruded through it into the peritoneal cavity, accompanied by profuse hæmorrhage. This is known as tubal abortion; and the term is applicable to cases in which hæmorrhage takes place from a gravid tube into the peritoneum through an unclosed ostium, the tube remaining whole. When the mole is also extruded, it is called *complete tubal abortion*; when retained, it is *incomplete tubal abortion*. The last is the more serious condition, as the bleeding from the tube may be frequently repeated; it must also be emphasised that the loss of blood which accompanies complete tubal abortion may be so great as to imperil the patient's life.

Rupture of the gestation sac.—It is an undeniable fact that nearly every gravid tube either aborts or ruptures. If from any cause the pregnancy is disturbed before the ostium is

occluded, the probability is in favour of tubal abortion; but the tube may rupture in spite of a patent ostium. If the pregnancy advances until after occlusion of the ostium, rupture of the tube is inevitable at some period between the sixth and tenth week following impregnation: it is rarely deferred to the twelfth week.

This is called primary rupture of the tube, and it may be (a) intra-peritoneal, or (b) extra-peritoneal.

The determining causes of the rupture are of various kinds:—jumping from a train, stool or carriage; straining during vomiting or defæcation; sexual congress, etc.

Primary intra-peritoneal rupture.—In this case the rupture is so situated that the blood escapes from the tube into the peritoneal cavity, and inundates the recto-vaginal pouch. The embryo and its membranes (or the mole) may escape through the rent, or be detained in the tube.

The blood effused may amount to a few ounces or four pints, or even more. Extravasations of this kind were formerly called pelvic hæmatoceles. This term could, with advantage to the student, suffer obliteration.

The dangers of primary intra-peritoneal rupture of a gravid tube are rapid death from hæmorrhage, or death from repeated hæmorrhage. Women occasionally survive a limited hæmorrhage, and the effused blood slowly absorbs.

When the bleeding is not excessive, the blood collects in the recto-vaginal fossa, and floats up the coils of intestines, and these, with the omentum, gradually form a covering to the fossa by adhering together, thus isolating the blood in the pelvis from the general peritoneal cavity. Unless hæmorrhage recurs, the fluid portion of the blood is slowly absorbed, but convalescence is tardy.

Taylor has shown that the effused blood in these cases sometimes coagulates in layers and forms a spurious cyst.

Primary extra-peritoneal rupture.—In a fair proportion of cases the tube ruptures in some portion of its circumference lying between the layers of the mesosalpinx. Under these conditions the blood leaks into the connective tissue between the layers of the broad ligament, and forms an accumulation known clinically as a "hæmatoma of the broad ligament." In the case of a mole, this accident is often a favourable termination of the pregnancy.

In a fair proportion of cases the leakage is not injurious to the embryo, and the rent in the tube gradually expands, and the embryo or its placenta slowly occupies the space between the layers of the broad ligament, which thus serve as boundaries to the gestation sac. The pregnancy is now referred to as a "broad ligament," or "mesometric pregnancy."

The placenta and decidua.—The tubal placenta presents some peculiarities, and is, moreover, liable to many vicissitudes which influence very materially the life of the fœtus. It is also a source of risk to the life of the mother, and causes under some conditions deep anxiety to the surgeon. A uterine placenta consists

of foetal and maternal elements, but a tubal placenta possesses foetal elements only (chorionic villi), for, in a tubal pregnancy, a decidua forms in the uterus, not in the tube; further, the tubal mucous membrane takes very little share in the formation of the placenta. It is the primitive character of the tubal placenta that helps to make the embryo's life so precarious.

After primary extra-peritoneal rupture of the tube, the future course of events is largely determined by the relative position of the foetus and placenta.

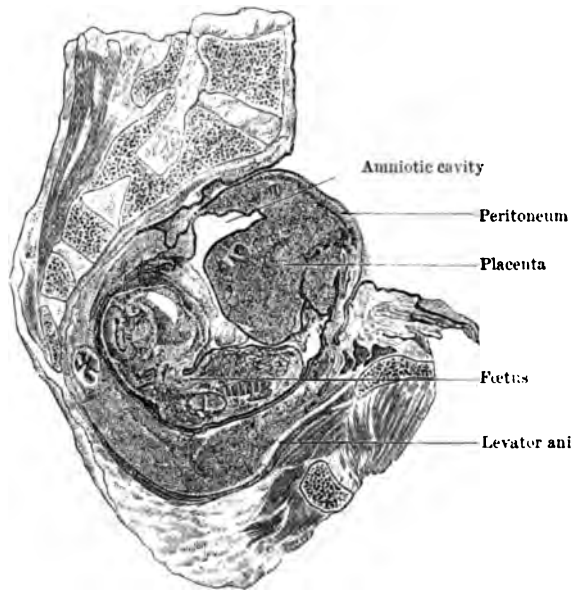


Fig. 938.—Section of the Pelvis: a foetus and placenta of the fourth month occupy the left mesometrium. (After Berry Hart.)

When the embryo is situated above the placenta, the latter gradually grows, and insinuates itself between the layers of the mesometrium (broad ligament) until it comes to rest upon the floor of the pelvis.

Should the embryo lie below the placenta, the foetus will ultimately come to rest on the pelvic floor, and the placenta will be pushed upwards by the growing foetus (Fig. 938).

This gradual displacement leads to serious and disastrous changes. For instance, repeated hæmorrhages seriously damage the placental tissue and impair its functions, and lead to arrest of development or death of the foetus. The constant tension to which the gestation sac is exposed may, if increased by a sudden hæmorrhage into the sac, lead to rupture and death. The events which may be expected when the embryo survives primary extra-peritoneal rupture are:—

1. Secondary rupture.
2. Death and sequestration of the foetus.

Secondary rupture.—When pregnancy continues between the layers of the mesometrium, the sac may rupture at any moment, and the risks of this accident, as far as can be judged with our present knowledge, are much greater when the placenta is situated above the fœtus. Should the rent involve the peritoneum and placenta, terrible hæmorrhage into the peritoneal cavity and speedy death are the almost inevitable consequences. When the fœtus lies above the placenta, the walls of the gestation sac may become so

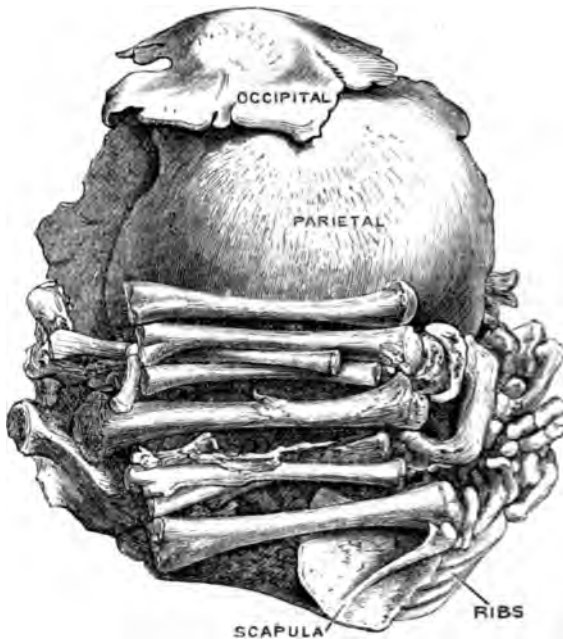


Fig. 939.—Macerated Skeleton of a Fœtus from the Mesometrium. (Museum, Middlesex Hospital.)

thin, that when it ruptures the fœtus in its amnion escapes into the peritoneal cavity. The two conditions just described are known as "secondary intra-peritoneal rupture." It must be borne in mind that secondary rupture, though the usual, is by no means a necessary or constant termination of broad ligament gestation. The pregnancy may go to term; then spurious labour supervenes, pains come on and persist for days, then slowly subside; the liquor amnii is absorbed, the fœtus dies, the fœtal circulation stops, the placenta atrophies, and the fœtus becomes mummified or partially calcified (lithopædion).

These mummified fœtuses may remain quiescent for many months or fifty years; indeed, may never cause subsequent trouble, but they are always potential sources of danger, for if septic organisms gain

access to the gestation sac from the intestine, rectum, vagina, etc., then suppuration with all its attendant evils is the consequence. Finally, the abscess bursts through the abdominal wall, rectum, bladder, uterus, or vagina, and fragments of fetal tissue and portions of the skeleton are discharged from time to time (Fig. 939). This termination is known as "secondary extra-peritoneal rupture."

Tubo-uterine gestation.—When a fertilised ovum lodges in the section of the tube which traverses the uterine wall, it is termed

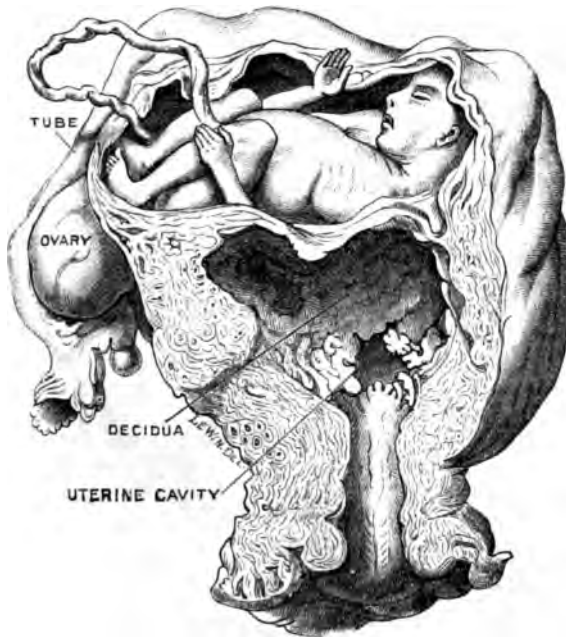


Fig. 940.—Tubo-uterine Gestation. (Museum, Guy's Hospital.)

tubo-uterine gestation (Fig. 940). It is very rare ; many specimens described under this name are examples of cornual pregnancy.

This runs a somewhat different course to the common variety of tubal pregnancy. The primary rupture in tubo-uterine gestation may be delayed till the sixteenth week. The sac may rupture in two directions. It may burst into the peritoneal cavity, and is often rapidly fatal ; or it may rupture into the uterine cavity and be discharged like a uterine embryo. A tubo-uterine sac never ruptures into the mesometrium (broad ligament).

Although in many examples of tubo-uterine gestation primary rupture may be longer delayed than in purely tubal gestation, nevertheless the sac sometimes bursts very early ; in such cases death usually takes place within a few hours from hæmorrhage.

Gestation in the rudimentary cornu of a unicorn uterus is not distinguishable during life from tubal gestation: it runs a similar course, and requires the same mode of treatment. This dangerous variety of pregnancy must not be confounded with gestation in one horn of a bicorned uterus, as this runs as safe a course as pregnancy in a uterus of normal shape.

Symptoms.—The signs of tubal pregnancy vary according to the stage to which the gestation has advanced. They must, therefore, be dealt with in the following stages:—

1. Before primary rupture or abortion.
2. At the time of primary rupture or abortion.
3. From the date of primary rupture to term.
4. At term.

Before proceeding to discuss the signs it is necessary to point out that the patient may be

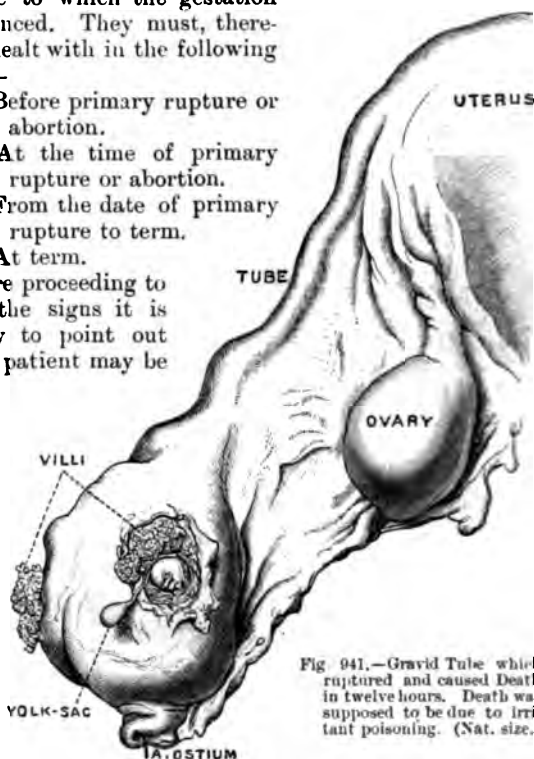


Fig. 941.—Gravid Tube which ruptured and caused Death in twelve hours. Death was supposed to be due to irritant poisoning. (Nat. size.)

aware that she is pregnant; in the majority of cases she is ignorant of the fact. In some instances the signs of pregnancy, for example, amenorrhœa, morning vomiting, and fulness of the breasts are present, as in uterine gestation; often they are entirely in abeyance. When the signs of pregnancy coexist with tubal gestation, they often give the clue for a correct diagnosis.

1. *Before primary rupture.*—Gravid tubes have, in many instances, been removed before primary rupture or abortion; in nearly all the recorded instances before 1891 the operations were undertaken for the purpose of removing diseased tubes. Examination of the parts removed revealed the fact that the tubes were

gravid. Since this date the pathology of the early stages of tubal pregnancy has been carefully investigated and a clear distinction recognised between a gravid tube and a hæmatosalpinx ; many cases have been recorded in which a correct diagnosis was made before the operation was undertaken. This is very gratifying, and it is a matter of great importance for the patient, as it spares her the awful peril that attends rupture of the tube.

2. *Primary rupture and abortion.*—The signs of intra-peritoneal rupture are those characteristic of internal hæmorrhage. The woman complains of "a sudden feeling as if something had given way." This is followed by pallor, faintness, sighing respiration, rapid and feeble pulse, depression of temperature, sometimes vomiting. Occasionally death ensues in a few hours (Fig. 941). Should she recover from the shock, then hæmorrhage takes place from the uterus, accompanied in some cases by the escape of shreds of decidua, which sometimes leads the practitioner to look upon the case as an ordinary abortion.

In extra-peritoneal rupture the symptoms are usually less severe, as the amount of blood lost is less than in the intra-peritoneal form, because the pressure exercised by the blood extravasated between the layers of the broad ligament tends to check the bleeding, whereas the peritoneal cavity will hold all the blood the patient possesses, and yet produce no hæmostatic effect in the form of pressure.

In primary extra-peritoneal rupture—that is, when the tube bursts so that the blood is extravasated between the layers of the broad ligament—the symptoms resemble intra-peritoneal rupture, but as a rule are not so severe, and the signs of shock pass off quicker. On examining by the vagina, a rounded ill-defined swelling occupies one or other broad ligament ; when the effused blood is large in amount the uterus will be pushed to the opposite side. When the bleeding takes place into the left broad ligament it will sometimes extend backwards under the peritoneum, and invade the connective tissue around the rectum, so that when the exploring finger is introduced into the rectum, a semicircle, sometimes a ring, of swollen tissue will be felt encircling the gut.

The escape of decidual membrane from the uterus accompanied by blood is also an important and fairly constant sign (Fig. 942). Occasionally it will be necessary to pass a sound into the uterus ; the cavity of this organ will be found slightly enlarged when the tube is gravid and the os is invariably patulous.

The greatest difficulty in these cases is to be sure that the rupture is purely extra-peritoneal. Cases occasionally come under



Fig. 942.—Uterine Decidua : from a case of tubal pregnancy. (Natural size.)

observation, in which the peritoneal, as well as the uncovered portion of the tube, is involved in the tear.

The signs of rupture of a gravid tube may be simulated by several conditions: (1) rupture of a pyosalpinx; (2) perforation of a gastric ulcer; (3) biliary, renal, and appendicular colic; (4) acute poisoning; (5) acute axial rotation of an ovarian tumour; (6) intestinal obstruction. On the other hand, the profound shock which usually accompanies the bursting of a gravid tube has been confounded with each of the above-mentioned lesions.

3. *From the date of pregnancy to term.*—Not infrequently after primary extra-peritoneal rupture the symptoms of shock pass off, and the embryo continues its development; in many instances the patients believe themselves pregnant, and the hæmorrhages from which they suffer, and the signs indicative of the primary rupture, may merely cause temporary inconvenience. As the embryo increases in size the abdomen enlarges, but differs from ordinary uterine gestation in that the enlargement is lateral instead of median.

From the third month onwards the leading signs of tubal gestation may be summarised thus:—

(a) Amenorrhœa is occasionally found; frequently there is hæmorrhage from the uterus, occurring at irregular intervals, accompanied by the escape of decidual membrane. This last is a valuable diagnostic sign. It is even more valuable if the patient has missed one or two periods.

(b) There may or may not be milk in the breasts. Its presence is a valuable indication. From its absence nothing can be inferred.

(c) The uterus is slightly enlarged; the os is usually soft, as in normal pregnancy, and patulous.

(d) A large and gradually increasing swelling to one side and behind the uterus. Occasionally the fetal heart can be heard, and in advanced cases the outlines of the fetus may be distinguished.

(e) When a woman in whom the existence of tubal gestation is suspected is suddenly seized with collapse, and all the signs of internal bleeding, it is indicative of rupture of the gestation sac.

(f) Tubal pregnancy is very apt to occur after long intervals of sterility.

4. *At term.*—In spite of all the risks that beset the life of a tubal fetus and that of its mother, the pregnancy may go to term. Then a remarkable series of events ensues.

(a) Paroxysmal pains come on, resembling those of natural labour, accompanied by a discharge of blood and mucus, and dilatation of the "os."

(b) This unavailing labour may last for hours or weeks.

(c) The mammæ may continue to secrete milk for several weeks.

These signs sometimes pass away, and as the amniotic fluid absorbs, the abdominal swelling subsides. Months or years later suppuration takes place in the sac, and fetal tissues may be discharged through the belly wall, rectum, vagina, bladder, etc., and give a clue to the character of the abscess.

The **diagnosis** of tubal gestation is sometimes extremely simple, at others very difficult and doubtful. The following list represents some of the more important conditions that have been confounded with it :—

1. Uterine gestation.
2. Pregnancy in one horn of a bicorned uterus.
3. Ovarian cyst.
4. Retroversion of a gravid uterus.
5. Uterine myoma.
6. Tumour of the broad ligament.
7. Fæces in the rectum.

Converse errors have been again and again committed. It should be remembered that—

1. Uterine and tubal pregnancy may coexist.
2. Uterine sometimes follows tubal pregnancy.
3. Tubal pregnancy may be bi-lateral.
4. Tubal pregnancy may be repeated.
5. Ovarian or parovarian tumour and a gravid tube may coexist.

In the very early stages a gravid tube is apt to be confounded with pyosalpinx, hydrosalpinx, and small ovarian tumours.

Treatment.—The risks and difficulties of an operation for tubal pregnancy depend mainly upon the stage at which it is required.

1. *Before primary rupture or abortion.*

Opportunities of removing a gravid tube before rupture are not common, because the pregnancy rarely causes trouble until the sac bursts or the tube aborts.

2. *At the time of primary rupture or abortion.*—The majority of cases of tubal pregnancy come under observation at the time of primary rupture or abortion, and this is usually some period between the fourth and twelfth week.

When the symptoms of hæmorrhage are unmistakable and the patient's life is in grave danger, abdominal section should be performed without delay, and the bleeding controlled, unless there is good evidence that the rupture is extra-peritoneal. The employment of this method is in strict accordance with the canon of surgery valid in other regions of the body, namely, arrest hæmorrhage at the earliest possible moment.

There are few accidents that test the skill, nerve, and resources of a surgeon more than an abdominal section for a suspected intra-peritoneal rupture of a gravid tube, and few operations are followed by such brilliant results.

The method of performing the operation before and at the time of primary rupture is identical with oöphorectomy.

Occasionally the rent in the tube will involve the fundus of the uterus, especially when the embryo is lodged near the uterus. Such rents should be carefully sutured with gut.

3. *Subsequent to primary rupture.*—Cases are submitted to

operation at periods varying from a few hours, days, weeks, or even months, after the tube has ruptured. In cases where the abdomen is opened within a few hours or days of primary rupture, the free blood in the peritoneal cavity is removed by sponges, or better still by a full stream of sterilised water at 110° Fahr.

4. *Broad ligament gestation.*—When a mole is displaced between the layers of the broad ligament, operative interference is rarely called for. When the embryo is living and continues to grow, then surgical interference may be demanded at any moment on account of secondary rupture.

When the gestation has not advanced beyond the fourth month, it is possible to remove the embryo, tube, ovary, and adjacent portion of the broad ligament with the placenta, and thoroughly to remove all blood-clot. Then, by transfixing the broad ligament and tying the parts with silk ligatures, the cavity may be completely obliterated, and the ovary, with that portion of the tube on the distal side of the ligature, cut away.

When gestation has advanced beyond the fourth month the placenta has become too large to be dealt with in this summary manner; at the same time, the sac has encroached upon the peritoneum belonging to adjacent organs, such as uterus and rectum, bladder, and not infrequently the anterior wall of the abdomen.

The sac must then be exposed through an abdominal incision, and the fœtus with the placenta and blood-clot evacuated: the oozing is then checked with sponges, and the edges of the sac are stitched to the wound and its cavity is drained.

After the fifth month operative measures for tubal gestation must be considered under two headings:—(1) The treatment of the sac; (2) the treatment of the placenta.

The treatment of the sac.—The gestation sac in the last stages of tubal pregnancy consists of the remnants of the expanded tube and the broad ligament, which may be thickened in some parts and expanded in others. To the walls of the sac coils of intestine and omentum usually adhere.

Experience indicates clearly enough that the safest plan is to incise the sac, remove the fœtus, and stitch the edges of the sac to the abdominal wound and drain it.

The most perplexing step is the treatment of the placenta. When the fœtus is alive, the rules on this point may be formulated thus:—

1. When the placenta is situated above the fœtus, it is good practice to attempt its removal with the fœtus.
2. In some instances the placenta becomes detached in the course of the operation, and leaves no choice.
3. When the placenta is below the fœtus, it may be left.
4. Should the placenta be left, and the sac closed, if symptoms of suppuration occur, then the wound must be re-opened and the placenta removed.

5. If the fœtus dies before the operation is attempted, the placenta can be removed without risk of hæmorrhage.

After the death and decomposition of the fœtus, the treatment is very simple; the resulting sinuses should be dilated, and all fragments removed from the cavity in which they lie. When this is thoroughly done, the sinuses will rapidly granulate and close. Partial operations are useless; if only a portion of a bone is allowed to remain, a troublesome sinus will persist.

The great risk of violent hæmorrhage from the placental site renders an operation for tubal pregnancy between the fifth and ninth months of gestation, the fœtus being alive, the most dangerous in



Fig. 943.—Left Ovary and Tube in their natural Relationship. (Natural size.)

the whole range of surgery; hence it cannot be urged with too much force, *when it is fairly evident that a woman has a tubal or a broad ligament pregnancy, it should be dealt with by operation without delay.*

THE OVARIES.

The many abnormal conditions to which the ovaries are liable may be conveniently discussed under the following headings:—

1. Misplacements.
2. Age changes.
3. The corpus luteum.
4. Inflammations.
5. Tumours.

1. **Misplacements.**—In the embryo each ovary lies in the loin in relation with the kidney; it gradually descends, and at birth

• • •

rests upon the *psoas magnus* muscle at the brim of the pelvis; after birth it moves to the permanent position in the true pelvis on the posterior aspect of the broad ligament. Its relation to the uterus and Fallopian tube in a young adult woman is shown in Fig. 943.

The ovary may never attain this position, for, like the testis, it may be retained in the renal region; or it may descend into the false pelvis, and remain fixed at the brim. Undescended ovaries are excessively rare, and usually unilateral.

Displacements from the normal adult position are of two kinds—hernia and prolapse.

Oöphorocele.—Hernia of an ovary is usually described as being congenital or acquired. It is, however, a curious fact that in many suspected cases of *congenital oöphorocele* the herniated bodies, when submitted to microscopical examination, proved to be testes. Although congenital inguinal herniæ are extremely common, no authentic case can be cited in which an ovary has been found in a hernial sac at birth. Cases reported as congenital herniæ of the ovaries may be found in great number, but no case has yet been reported in which the ovarian nature of the herniated body was microscopically demonstrated.

An *acquired oöphorocele* is a reality; it may occupy the inguinal or the femoral canal. Very rarely the ovary and tube have been found in the sac of an obturator hernia. The ovary may occupy the sac alone, but it is usually accompanied by the fimbriated end of the tube. Sometimes the ovary and part of the tube occupy a hernial sac in common with intestine, omentum, or bladder, and occasionally the upper end of a cornu of a bicorned uterus.

The signs are those common to inguinal and femoral herniæ: the ovary and tube may be strangulated or twisted, and give rise to signs indistinguishable from those characteristic of strangulated gut or omentum. Acquired oöphoroceles occur at any period of life. Strangulated oöphoroceles have been observed as early as the third month of life (Bilton Pollard), and as late as the seventy-fifth year (Maylard).

There are no symptoms by which an oöphorocele, reducible or strangulated, can be differentiated from an enterocoele or an epiplocele. (See also page 724.)

Prolapse of the ovary.—An ovary is very apt to be displaced from its position at the brim of the true pelvis into the deeper parts of the recto-vaginal fossa. This displacement, known as "prolapse of the ovary," may be due to pregnancy, retroflexion of the uterus, and a small tumour of the ovary.

When prolapsed, an ovary lies between the upper part of the vagina and the rectum, and is often a source of pain during defecation and sexual congress.

A prolapsed ovary can be felt as a rounded body, usually very mobile, lying behind the uterus. When pressed by the finger it is a source of pain; also when the neck of the uterus is pressed,

because the ovary is then squeezed between the uterus and rectum, or uterus and sacrum.

2. Age changes.—The variations in the shape of the ovaries from infancy to old age are very marked. At birth an ovary is an elongated body, resembling in shape a miniature, but somewhat flattened, cucumber, lying parallel with the Fallopian tube; not infrequently its borders are crenate, and sometimes a longitudinal furrow is present on its free surface (Fig. 944).

The infantile form of ovary gradually changes, and at puberty it has become transformed into the characteristic olive-shaped gland, indicative of the sexually mature female. From the accession of puberty until the forty-fifth year the general contour of the ovary remains undisturbed, but the smoothness of the surface is marred by scars, the effects of repeated lacerations, caused by the bursting of mature follicles. In rare instances the infantile shape of the ovary may be retained.

From the age of forty-five onwards the ovary diminishes in size; this alteration is accompanied by arrest of menstruation. As the organ shrinks the surface becomes irregular, and often marked with deep wrinkles.

The uterus and tubes undergo a corresponding diminution in size, and the endometrium atrophies.

3. The corpus luteum.—When the contents of a mature ovarian follicle are discharged, the cavity of the follicle, at first filled with blood, becomes gradually occupied by reddish-yellow tissue, which assumes an irregular shape, and forms a body termed the *corpus luteum*. Should the ovum become fertilised, the corpus luteum increases in size, and persists as a conspicuous object in the ovary throughout the whole period of gestation.

In an unimpregnated female the corpus luteum begins to degenerate within ten or fourteen days after the escape of the ovum, and finally disappears.

It is necessary to bear in mind that a large or true corpus luteum is usually, but by no means always, present during pregnancy, uterine and tubal. A large true corpus luteum is occasionally seen in cases of uterine myomata and in sterile women. Thus its presence or absence cannot be relied upon as an absolute test of pregnancy, or the reverse. The corpus luteum is liable to the following changes:—It may become cystic; it may be a source of corpora fibrosa, or of concretions.

Cystic corpora lutea.—The normal corpus luteum is usually occupied by a central cavity. This sometimes becomes large enough

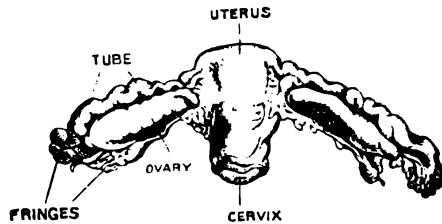


Fig. 944.—Uterus, Tubes and Ovaries of an Infant one month old. (Natural size.)

to form a tumour clinically recognisable. A cystic corpus luteum rarely exceeds a Tangerine orange in size. In fresh specimens the walls of these cysts are of a bright yellow colour, and are thus easily identified.

Corpora fibrosa.—These are tough, semi-opaque, fibrous bodies, probably due to fibrous changes in the tissue of the corpus luteum. Some corpora fibrosa contain a small central cavity, others a laminated body, possibly due to a colloid change of the central parts of the corpus luteum. Occasionally a corpus fibrosum attains the size of a bantam's egg; it may become pedunculated.

Concretions.—Ovarian concretions are of two kinds :—(1) Blood concretions; (2) calcified corpora lutea.

(1) *Blood concretions.*—Hæmorrhage into the ovarian follicles is by no means uncommon, indeed, it is a natural sequence of their rupture when mature. Occasionally blood is effused into ripening follicles independently of their rupture. Follicular hæmorrhages of this character have been found in women who have died from burns, typhoid, and other fevers, and phosphorus poisoning.

Sometimes blood is extravasated so freely into a follicle that it bursts the walls and invades the stroma. To this condition the name "apoplexy of the ovary" is applied.

When blood is effused into an ovarian follicle it may, in very rare instances, undergo a peculiar colloid change, and form concretions which present facets such as are found on gall-stones.

(2) *Calcified corpora lutea.*—These may occur singly or multiple. They may be of irregular shape, or present a rounded, but rough, surface. As a rule, they are firmly embedded in the ovarian stroma.

4. Inflammations.—Inflammation of the ovary, acute and chronic, is so constantly associated with salpingitis, and, in nearly all cases, secondary to it, that the chief points in the pathology, diagnosis, and treatment of the affection were dealt with in the section devoted to salpingitis.

There are two varieties of oöphoritis, apart from septic inflammation, conveyed through the tube which require separate consideration :—(1) Oöphoritis secondary to parotitis (mumps), and (2) tuberculosis of the ovary.

(1) **Oöphoritis and mumps.**—Girls and young women, during an attack of mumps, occasionally complain of pelvic pain. In a few cases, where the suffering has been sufficiently severe to warrant a vaginal examination, the ovaries have been found enlarged, tender, and painful. As a rule, the ovaries are affected during the subsidence of mumps. In a few exceptional cases the pelvic pain has preceded the parotid signs.

In this connection it is important to bear in mind that parotitis is not infrequently a sequel to injuries of, and operations upon abdominal and especially pelvic viscera.

At present there is no explanation forthcoming of the relation of oöphoritis as a sequel of mumps. Indeed, the whole of the evidence rests on clinical observation.

(2) **Tuberculosis of the ovary.**—In many cases tubercle of the ovary is secondary to tuberculous salpingitis; in others, it occurs as part of a general tuberculosis, and is especially associated with tubercle of the peritoneum,

Primary tubercle of the ovary is a rare affection. An ovarian abscess, unassociated with salpingitis, is, in nearly all cases, tuberculous, and lesions occur in other organs, such as the lungs, bones, etc.

The course of an ovarian abscess is described under pyosalpinx and tubo-ovarian abscess, page 1049.

A very rare cause of abscess in an ovary is a foreign body. Haviland removed a suppurating ovary from a woman twenty-one years old. On examining it a piece of a sewing needle 2 cm. long was found in the abscess cavity.

Perioöphoritis.—Chronic inflammation of the peritoneum in the immediate neighbourhood of an ovary is almost certain to involve the capsule of this gland. Thus, after salpingitis, pelvic peritonitis, and pelvic cellulitis, the superficial parts of the ovary are involved in adhesions, and become bound to the tubes, broad ligaments, rectum, vermiform appendix, or small intestine.

In the very late stages of salpingitis, when the tube becomes sclerosed, the ovary becomes similarly changed. Its superficial parts are converted into tissue as dense as that of a cicatrix, and as it contracts the ovary dwindles, and its follicles, in many instances, are completely effaced.

These changes, in a measure, explain the pain so often experienced by young women in the course of chronic salpingitis. When the follicles mature, their enlargement is interfered with by this dense covering, and the tension probably produces suffering. This, however, is not the only source of pain, for the suffering often continues after the ovaries have been removed.

Perioöphoritis is said to occur as a sequel to typhoid fever, rheumatism, the exanthemata, and as a consequence of alcoholism. It is frequently seen *post mortem* as a consequence of ascites.

The chief results of perioöphoritis are painful menstruation (dysmenorrhœa) and sterility.

Ovarian pregnancy.—The belief that an ovum may become fertilised and engraft itself upon the ovarian tissues and develop into a fetus has no foundation in fact. Many cases formerly described as examples of ovarian pregnancies turn out on critical examination to be ovarian dermoids, and in others examples of partially calcified or mummified fœtuses in the broad ligaments, the result of tubal pregnancy. Many of the modern cases rest upon no safer evidence than the non-detection of the ovary during an operation upon, or *post-mortem* examination of, a subject of advanced tubal gestation.

5. **Tumours.**—The ovary is, with extraordinary frequency, the seat of tumours. They belong to the following genera :—(1) fibroma; (2) myoma; (3) sarcoma; (4) carcinoma; (5) dermoids and cysts.

1. **Fibroma.**—Tumours composed entirely of firm fibrous tissue

have been described ; some of them have attained a weight of ten pounds. Ovarian fibromata are very rare. Many examples described as such were subsequently demonstrated to be spindle-celled sarcomata.

2. **Myomata.**—Tumours composed of unstriped muscle tissue are very rare in the ovary. They may attain large sizes, and with the microscope, as well as the naked eye, are indistinguishable from uterine myomata.

3. **Sarcomata.**—The ovary, like the testis, kidney, and retina, is prone to become the seat of sarcomata during early life ; to this succeeds a period of comparative immunity, followed by a second period of renewed but diminished liability.

The sarcomata of infant life attack both ovaries in more than half the cases ; grow rapidly, attain formidable sizes, and quickly destroy life.

Structurally, they consist of round- and spindle-celled elements, in which collections of cells are often conspicuous, resembling the alveolar disposition characteristic of cancer. These supposed alveoli are ovarian follicles entangled in the general overgrowth of the ovarian stroma.

The first period of exceptional liability ends at puberty ; ovarian sarcomata are very rare from the sixteenth to the twenty-fifth year. From this age to forty-five they are occasionally met with, and are in most cases unilateral. They rapidly destroy life. Ascites complicates the late stages.

4. **Carcinoma.**—Many tumours described as cancer of the ovary are sarcomata, the alveolar disposition being due to ovarian follicles entangled in sarcomatous tissue. Primary cancer of the ovary requires further investigation. Infection of the ovary, secondary to cancer of the mamma or the uterus, is very common.

5. **Dermoids and cysts.**—Before proceeding to discuss dermoids and cysts, it will be necessary to remind the student that the ovary consists of an egg-bearing portion, the oöphoron, and a region, the paroöphoron, in which no ova are found (Fig. 947).

The *cysts of the oöphoron* are of three varieties :—

- a. Simple cysts.
- b. Adenomata.
- c. Dermoids.

(a) *Simple cysts.*—These may be unilocular or multilocular. When the cysts are large it is difficult to demonstrate the epithelial lining on the interior of the loculi, but in their early stages they have a *membrana granulosa*. When they attain the size of a melon, stratified epithelium may be sometimes demonstrated. In very large cysts, such, for instance, as have a capacity of one or more gallons, the walls consist of fibrous tissue only, the epithelium atrophies from the pressure to which it has been subjected.

(b) *Adenomata.*—These are always multilocular. They have a fibrous capsule, through which the various loculi project and produce a lobulated surface. On section the tumour displays a honeycomb

appearance, the loculi of which are of various shapes and sizes; many do not exceed 1 cm. in diameter, others are as large as melons. These cavities are filled with a viscid fluid identical in its physical characters with mucus. The walls of many of the smaller loculi are covered with a regular layer of tall columnar epithelium; many of them contain in addition complex mucous glands, and others are indistinguishable from ovarian follicles. When these tumours are fresh, if some of the smaller loculi are punctured with a knife and the fluid watched as it flows through the opening, a small opaque body about the size of a rape-seed will be detected; it floats on the mucus like the cicatriculum on the yolk of an egg.

(c) *Dermoids*.—A very large proportion of cysts of the oöphoron contain skin or mucous membrane, or both these structures, and one or many of the structures peculiar to them. The morphology of these extraordinary tumours is discussed on p. 490, Vol. I.

The degree of development of the various dermic structures varies in different cases. Thus, in one case hair preponderates, in another teeth (Figs. 945, 946). When the mucous glands are abundant the tumour is usually termed an adenoma. When sebaceous glands are predominant, then a mamma may be formed or a pedunculated adenoma (Fig. 949). When the epidermis is abundant, its flakes may collect round a hair and become rolled into small bodies of the size and shape of pills. As many as 3,930 of these pill-like bodies have been observed in a single cyst.

Tumours of the oöphoron, whether simple, adenomatous, or dermoid, sometimes attain prodigious proportions—fifty, sixty, and hundred and sixty pounds. They occur at all ages from foetal life to ninety-four years; but there is no satisfactory evidence of a dermoid having been observed before the end of the first year of life.

Cysts of the paroöphoron.—These differ from cysts of the oöphoron in the fact that they do not affect the shape of the ovaries until they have attained large proportions; they are almost invariably unilocular, and the inner walls are richly beset with warts, which in many examples are so abundant as to cause the cyst to burst. Papillomatous cysts are usually met with between the twenty-fifth and fiftieth years.

Cysts of the parovarium.—When small, parovarian cysts are transparent, and have very thin walls, but after they attain the size of a cocoanut the walls become thick, and the mesosalpinx in relation with the cyst thickens, and sometimes the muscle fibre contained in this part of the broad ligament is greatly increased. Parovarian cysts may attain a capacity of five gallons.

Small parovarian cysts are lined with columnar epithelium, which is ciliated in some specimens. In large cysts the epithelium stratifies, and in very big cysts it atrophies.

The fluid in small cysts is limpid, slightly opalescent, sp. gr. 1,002 to 1,007, and contains a substance which forms a flocculent



by its tunica vaginalis, but with this difference, the Fallopian tube communicates with it by means of its abdominal ostium. Should the sac become distended with fluid, it is then termed an ovarian hydrocele, and sometimes attains a large size.

An ovarian hydrocele presents the following characters:—The sac projects from and is intimately incorporated with the posterior layer of the broad ligament; the tube lies on the crown of the cyst, its outer half is dilated and tortuous, and its ostium opens into the hydrocele by a circular aperture. In the early stages the ovary projects into the cavity of the cyst, but in large examples it atrophies. The general appearance of a typical ovarian hydrocele suggests “a retort with a convoluted delivery-tube” (Griffith). The condition most liable to be confounded with an ovarian hydrocele is a large hydrosalpinx.

Gartnerian cysts.—

In the section devoted to diseases of the vagina (page 1028), mention was made of cysts arising in the lower end of Gartner's duct. There is reason to believe that some papillomatous cysts of the broad ligament, described as cysts of the paroöphoron, which lie in close relation to the sides of the uterus, arise in this duct.

Relations of ovarian cysts.—The cysts of the ovary and parovarium exhibit definite relations to the broad ligament and Fallopian tube, which it is important to appreciate.

Cysts of the oöphoron.—The Fallopian tube lies curled on the cyst; the mesosalpinx is unaffected. These cysts rarely burrow between the layers of the broad ligament. The ovary is incorporated with the tumour.

Cysts of the paroöphoron.—The tube is stretched across the cyst, which, when small, burrows between the layers of the broad ligament and mesosalpinx. Large cysts raise the posterior layer of the broad ligament, and burrow deeply and strip the peritoneum as high as the brim of the pelvis. The oöphoron is free in small, destroyed in large specimens.

Cysts of the parovarium.—The tube is stretched across the cyst, which always lies between the layers of the mesosalpinx, but never burrows deeply into the pelvis. The ovary is free (Fig. 947).



Fig. 946 — Calcified Ovarian Dermoid containing Hair and Teeth. (Museum, Middlesex Hospital.)

Ovarian hydroceles.—The tube is contorted, rests upon the crown of the cyst, and opens into the sac by its abdominal ostium. The sac is intimately connected with the posterior lamina of the broad ligament. The ovary projects in the sac of small, but is destroyed in large hydroceles (Fig. 948).

Secondary changes in ovarian cysts.—Ovarian cysts, using the term in a broad clinical sense to include the four species just considered, are liable to three important changes: (1) axial rotation; (2) rupture; and (3) suppuration.

1. *Axial rotation.*—Ovarian cysts, in common with many varieties of pedunculated cysts, are liable to rotate on their axes, a movement which leads to torsion of the pedicle (Fig. 949) and consequent interference with the circulation of the tumour. When the torsion is acute,



Fig. 947.—Parovarian Cyst. (Museum, Middlesex Hospital.)
A, Oöphoron; B, paroöphoron; F, Fallopian tube.

severe pain and venous engorgement are the usual effects; when the rotation occurs slowly, it may so completely arrest the venous and arterial currents through the pedicle that growth is arrested, and in exceptional cases the cyst slowly atrophies. In a small proportion of cases the life of the tumour is preserved, in consequence of adhesions it acquires to surrounding tissues, especially omentum. When this happens the original connections of the cyst with the uterus are gradually severed, and its nutrition is derived from the omentum in virtue of new vessels formed in the adhesions. When an operation is carried out for the removal of such a tumour, the surgeon is surprised to find a dermoid with a Fallopian tube hanging from the omentum, or even connected with the cæcum.

2. *Rupture.*—When parovarian cysts rupture, the bland fluid causes no offence to the peritoneum; it is quickly absorbed, copious diuresis follows, and the cyst, as a rule, refills.

The rupture of a paroöphoronic cyst gives rise to curious changes. The fluid contents of these cysts are charged with epithelial

cells; these are deposited on the peritoneum, and grow into warts. They are most abundant on the pelvic peritoneum. After removal of the cysts the warts often disappear.

When cysts of the oöphoron rupture, the results depend on the nature of the cyst contents. Thus in the case of simple cysts the fluid is absorbed. When the cyst contains thick mucus no absorption occurs, and it accumulates in great quantity in the peritoneum.

The rupture of a dermoid may lead to the formation of secondary dermoids on the peritoneum. Epithelial infection of this kind may take the form of minute granules on the peritoneum, each of which is furnished with a tuft of delicate lanugo-like hair, or they may

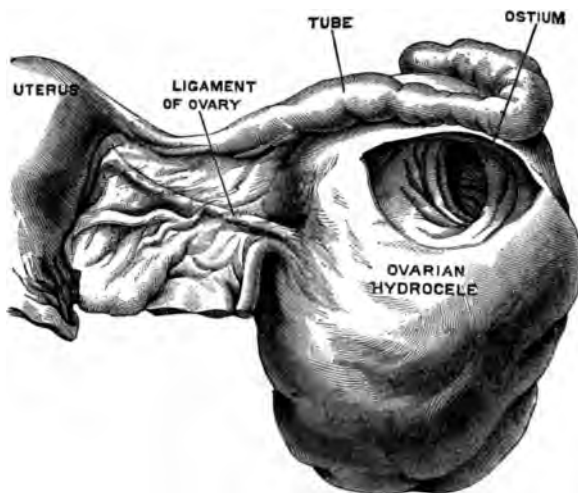


Fig. 948.—Ovarian Hydrocele. (Museum, St. Bartholomew's Hospital.)

give rise to tumours as large as cherries, or even Tangerine oranges. These may hang from the under surface of the liver or form clusters like "cherries upon a branch," or be embedded in adhesions between coils of intestine. Epithelial infection, whether it complicates papillomatous cysts or ovarian dermoids, usually leads to hydro-peritoneum.

3. *Suppuration*.—When air or intestinal gases gain access to ovarian dermoids, then suppuration with all its attendant evils is the result. Contamination may arise from puncture with a trochar or aspirating needle. More frequently it is due to entrance of gases from the intestine, due to adhesion of the bowel to some part of the cyst wall, with subsequent thinning of the adherent parts, until the septum becomes so thin that osmosis of intestinal gases occurs and fouls the cyst. When suppuration occurs, the pus may find an outlet through the rectum, vagina, or bladder. Sometimes a sinus

forms in the anterior abdominal wall, and it is not rare in such cases for the pus to point at the umbilicus.

Symptoms of ovarian cysts. — The signs or conditions that lead a woman with an ovarian tumour to seek advice vary according to its size. For instance, when the tumour remains restricted to the pelvis the troubles it may cause are different

Twisted pedicle

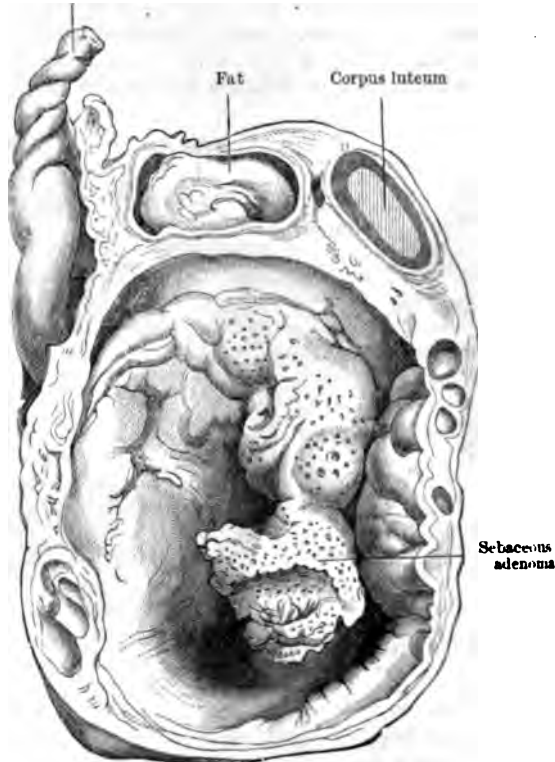


Fig. 949.—Ovarian Dermoid with twisted Pedicle.

to those produced when it is large enough to rise above the pelvic brim and occupy the abdomen. When the tumour is large enough to rise up out of the pelvis the only troublesome symptom, in a very large number of cases, is progressive enlargement of the belly. This, in married women, is often attributed to pregnancy; in young unmarried women it is a source of annoyance, as it leads occasionally to suspicion of pregnancy.

Should complications arise (such as axial rotation, inflammation, or suppuration of the cyst), they will lead to detection of the tumour. The pressure effects induced by ovarian tumours, such as troubles

with the bladder, hydronephrosis, œdema of the leg, and dyspnœa, induce patients to seek advice.

When the tumour is not too large to be accommodated in the pelvis it causes trouble by becoming impacted, and exercising baleful pressure on bladder, ureter, rectum, and intestines.

It may impede delivery and lead to rupture of the uterus, or it may twist its pedicle, suppurate, or constrict a coil of intestine, and produce fatal intestinal obstruction.

Diagnosis of ovarian cysts.—The clinical recognition of a large uncomplicated ovarian cyst is one of the simplest processes in clinical surgery. The signs may be thus summarised :—A swelling of the abdomen most marked below the umbilicus, associated with absolute dullness to percussion all over the tumour, most marked on its summit, and tailing away to resonance in the flanks ; such dullness is not affected by alteration in the position of the patient. If such signs be associated with a uterus of normal size, the presumption that the swelling is an ovarian tumour is as certain as most things in clinical medicine.

The diagnosis of simple cases of ovarian tumour rarely gives rise to difficulty if the surgeon duly weighs the various signs together, and does not place too much reliance on any one of them. Difficulty arises sometimes in distinguishing between ovarian tumours and conditions which simulate them ; the greatest care and skill are needed when diagnosis is complicated by secondary changes in the cyst, and by the coexistence of other tumours, abnormal conditions of the abdominal viscera, ascites, or pregnancy.

The diagnosis of ovarian tumours involves the question of the diagnosis of abdominal swellings in general. Indeed, there is no organ in the belly that has not at some time or other given rise to signs resembling those presented by an ovarian cyst. These facts alone will serve to show that there is no pathognomonic sign indicative of an ovarian tumour. In many cases the methods of physical examination are incompetent to enable us to form a correct opinion of the nature of an abdominal tumour until it has been actually exposed to view ; even with the abdomen open doubts and difficulties sometimes arise. It will be useful to mention the various conditions that have been mistaken for ovarian tumours, and *vice versa*. Of these the most important are :—Ascites, pregnancy, normal and abnormal, uterine myomata, hydrometra, phantom tumour (pseudocyesis), obesity, fœcal accumulations, and an overfull bladder.

Among rarer conditions the following may be mentioned :—Hydronephrosis, hydatids (echinococcus cysts), enlarged or wandering spleens, enlarged livers, distended gall bladder (hydrocholecyst), distended Fallopian tube (page 1048), fatty tumour of broad ligament, pancreatic cysts, chyle cysts of the mesentery, fluid accumulations in the lesser bag of the peritoneum.

When ovarian tumours of moderate size undergo secondary changes, such as rotation, inflammation, or suppuration, they may simulate a

variety of conditions, such as pelvic abscess, suppurative and tuberculous peritonitis, perforation of a gastric ulcer, perityphlitis, typhoid fever, volvulus of the intestine, retro-peritoneal hernia, and cancer of the colon.

The differential diagnosis of small ovarian tumours, confined to the pelvis, is discussed on page 1083.

Treatment of ovarian cysts.—The treatment of ovarian tumours, with the exception of sarcomata, is early removal. It has been proved by an overwhelming amount of evidence that the earlier these tumours are removed, that is, before they have acquired complicated adhesions to important organs, or produced dangerous pressure-effects upon the kidneys, the more likely is the operation to be followed by success.

When ovariectomy is necessary during pregnancy, it should be performed if possible before the fourth month. When the tumour is discovered during delivery, and this event is followed by ominous signs, ovariectomy should be performed. It has been successfully carried out within three days of delivery.

Ovariectomy has been successful on infants of twenty months, and women of ninety-four years.

Ovariectomy for sarcoma of the ovary is not followed with good results: the mortality is high, convalescence is tardy, and rapid recurrence and speedy death are the rule.

In experienced hands ovariectomy has become a fairly safe operation, but it is surrounded by many dangers, and is liable to be followed by certain sequelæ. The chief dangers of the operation are these:—Shock; injuries to viscera, such as bladder, ureter, intestines, and rectum; hæmorrhage from adhesions, and slipping of a badly-applied ligature; peritonitis; tetanus; sloughing of stump; intestinal obstruction; sponges, forceps, compresses, etc., left in belly; thrombosis and embolism; parotitis and acute mania.

The sequelæ are not unimportant. Of these the chief are:—A yielding cicatrix allowing of ventral hernia; fæcal fistula; sinus due to septic ligature; and a liability to intestinal obstruction from adhesion to the stump of the pedicle.

If both ovaries be removed, flushings, amenorrhœa, and sterility are the most important consequences.

THE PELVIC PERITONEUM.

In this section the following conditions will be considered:—(1) Diseases of the mesometrium (broad ligament). (2) Abnormalities and diseases of the pelvic peritoneum.

Diseases of the mesometrium.—The various affections of this structure are:—(a) Cellulitis (parametritis); (b) abscess; (c) hæmatoma and pregnancy; (d) tumours; (e) echinococcus cysts.

(a) **Pelvic cellulitis** (parametritis) signifies inflammation of the connective tissue between the folds of the mesometrium; it is a frequent complication of abortion, labour, instrumental delivery,

artificial dilatation of the cervical canal, operations on the cervix and uterus, and salpingitis.

Pathologically, pelvic cellulitis does not differ from septic inflammation of connective tissue in more superficial regions of the body. The change consists in the infiltration of the connective tissue of the mesometrium with inflammatory products, and the effects depend upon the extent of tissue involved, and the nature of the virus.

In some cases the infiltration extends into one half of the mesometrium, and involves the connective tissue around the cervix, so that the uterus is fixed as in a bed of plastic material. Sometimes the inflammation extends along the round ligament of the uterus, and gives rise to a firm swelling in the inguinal region; occasionally the exudation surrounds the rectum. Less frequently the connective tissue of the cave of Retzius is implicated, and a large, hard swelling forms in the hypogastric region (Fig. 950) (anterior parametritis). This condition usually produces very distressing vesical irritation. In a very large proportion of cases the swelling subsides in from three to five weeks; in others it persists, and slowly extends to the subserous tissue of the anterior abdominal wall. In a certain proportion of cases suppuration occurs, and an abscess forms in the broad ligament.

(b) **Pelvic abscess.**—An abscess in the broad ligament arises from many causes, such as pelvic cellulitis (parametritis), suppurating hæmatoma, a gestation sac, hydatids (echinococcus cyst), pericæcal abscess, puncture of the bladder.

Pus between the layers of the mesometrium may escape in many directions: into the rectum, vagina, or bladder. It may point in the groin, immediately above or below Poupart's ligament; the pus will sometimes burrow beneath the fascia lata, and point in the middle of the thigh, usually on the outer side. Occasionally it travels by the side of the urachus and points at the navel; exceptionally it will burrow through the greater sciatic notch and point on the buttock.

Signs.—The onset of pelvic cellulitis is usually marked by a rigor, followed by pain in one or both flanks; febrile symptoms supervene, and, as the exudation increases, troubles during micturition or defæcation are experienced.

These signs are of greater significance when they follow abortion, delivery, or operation on the uterus, within twenty-four or thirty-six hours.

Diagnosis.—On examining through the vagina, a hard mass will be found occupying one or both broad ligaments; in many cases the hard masses are conjoined by a ring of hard tissue surrounding the neck of the uterus. When the whole extent of the ligaments is infiltrated the swelling is perceptible at the brim of the pelvis, and in the hypogastrium.

When suppuration occurs, the temperature, pulse, and general condition of the patient are those accompanying large collections of pus. The local signs are softening of the previously hard masses,

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and often fluctuation is detected, or the overlying skin reddens, and the pus "points." Sometimes the first unmistakable evidence of the presence of pus is its sudden escape by the rectum, vagina, or bladder.

Treatment.—In the acute stages the patient is confined to bed, the bowels are kept regular by means of saline purgatives, and warm

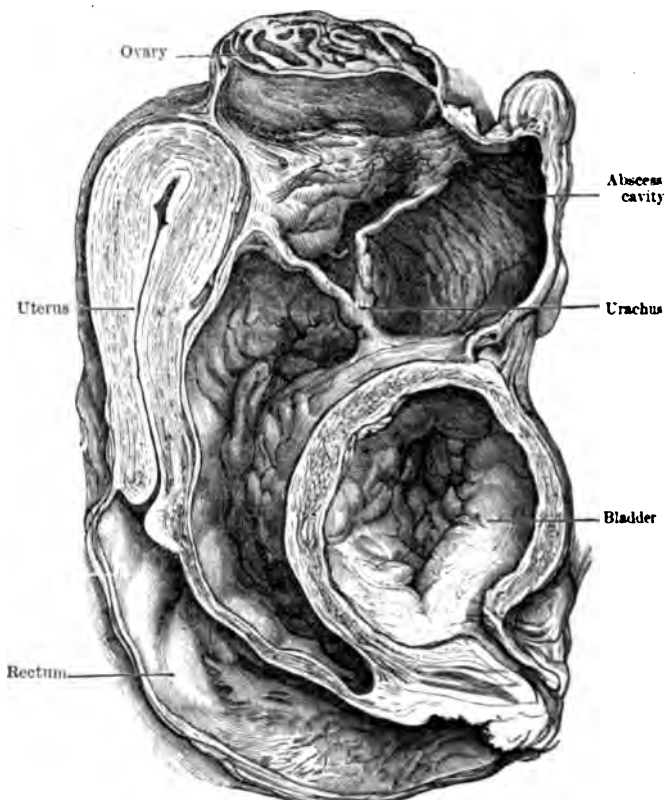


Fig. 950.—Sagittal Section of the Parts concerned in Anterior Parametritis. (Museum, Royal College of Surgeons.)

vaginal douches are frequently administered by a careful nurse. When there is much abdominal pain, warm fomentations to the hypogastrium give great relief.

When suppuration occurs, and the pus can be localised, an incision should be made into it, and the abscess drained. It is preferable to evacuate an abscess of the broad ligament through the belly wall than by an incision in the vagina. Should the abscess burst into the vagina, the aperture of communication is apt to close, and defective drainage leads to re-accumulation of pus; in these

circumstances it is advisable to dilate the opening to ensure drainage. When the abscess is due to suppuration of a gestation sac, the sinus should be enlarged, and all fragments of bone and other foetal tissues removed.

As in all cases of prolonged suppuration the patient's strength must be supported by nutritious and easily digestible food; quinine and iron preparations are useful, and health should be finally restored by change of air.

(c) **Hæmatoma and pregnancy.**—See pages 1056 and 1064.

(d) **Tumours.**—The mesometrium contains a large number of structures that are potential sources of tumours. Some have already been considered, but it will be useful to recapitulate them. They are:—The uterus with its round ligaments; the unstriped muscle tissue of the mesometrium, which may be regarded as the lateral extension of the uterine platysma, and on each side the Fallopian tube, the ovary and its ligaments, the parovarium, Gartner's duct, the ureter, and occasionally fat.

The following tumours occur between the layers of the mesometrium, or in very close relation with it:—Myomata growing from the sides of the uterus are apt to burrow between its layers; myomata of the round ligament of uterus or ovary, and of the broad ligament itself: these will be separately considered. Distended Fallopian tubes (whether in the condition of pyosalpinx, hydrosalpinx, or gravid) burrow between the layers of the mesometrium. The more distended the tube the more obviously it burrows. Oöphoronic cysts rarely, but paroöphoronic and parovarian cysts always, separate the layers of the mesosalpinx, or the deeper parts of the broad ligament. Gartnerian cysts, arising in the upper or the middle thirds of the duct, necessarily burrow between the layers of the mesometrium. Extreme dilatation of the lower segment of the ureter may occasionally be detected as a swelling immediately above the fornix of the vagina. Lipoma of the mesometrium is a rarity, but a reality; in, at least, one case a fatty tumour in this situation attained such a size as to rise above the pelvic brim and simulate an ovarian tumour. (Treves.)

The ovarian ligament.—Myomata of this structure are very rare. Specimens have been observed as large as a fist. They simulate small ovarian tumours, and require the same treatment—that is, removal.

The round ligament of the uterus.—Myomata and fibro-myomata occasionally arise from this structure, as it traverses the broad ligament. They are rare. Several examples have been recorded in connection with the part of this ligament which traverses the inguinal canal. They are oval in shape, and have been reported as big as cocoanuts.

True mesometric myomata.—The connective tissue of the broad ligaments contains a quantity of plain muscle fibre, directly continuous with the superficial layers of the uterus. This tissue is occasionally the source of myomata. These tumours are, as a rule,

bilateral, and when of moderate size, mobile, ovoid in shape, and easily enucleated. After a time they grow with great rapidity, and may in a few months attain a weight of twenty pounds or more. As the tumour rises out of the pelvis it carries the uterus and its appendages with it. The rapid growth and the profound way these large tumours affect the patient's health are due to septic infection of the tumour. The tissue of such myomata is very liable to become myxomatous, and large cavities form in them; calcification is not infrequent.

Mesometric myomata occur after the thirty-fifth year. They are very formidable tumours to deal with; the best method of treating them is enucleation, even the largest examples. More than half the cases succumb if operation be delayed until the tumour rises above the pelvic brim.

(e) **Echinococcus cysts** (hydatids).—These are very rare in England. Many cases have been recorded in which the cyst arose in the connective tissue beneath the pelvic peritoneum, and communicated with the rectum, or vagina, or bladder.

Abnormal disposition and diseases of the pelvic peritoneum.—The peritoneum is reflected over the pelvic viscera of women in such a manner as to form two fossæ—the recto-vaginal and recto-vesical.

When the uterus is bicorned the recto-vaginal fossa is subdivided by a median sagittal fold into a right and a left pouch. Occasionally a deep pouch or diverticulum extends from the bottom of the fossa, and burrowing between the rectum and vagina, protrudes the posterior vaginal wall.

When fluids are effused into the peritoneal cavity they gravitate to the pelvis and occupy these fossæ, especially the recto-vaginal (pouch of Douglas). The Fallopian tubes open directly into the recto-vaginal fossa.

Affections of the pelvic peritoneum.—These may be considered in two groups:—

(a) Effusions.

(b) Inflammations.

(a) *Effusions.*—These may be due to the gravitation of fluid effused in ascites or hydroperitoneum; bile from a ruptured gall-bladder; blood from rupture of the liver, spleen, abdominal aneurysm, uterus, or gravid tube (collections of blood are occasionally called pelvic hæmatoceles, a term fast becoming obsolete); fluid from ruptured echinococcus and ovarian cysts; faeces from perforation of intestine, or food from rupture or perforation of the stomach.

(b) *Inflammation* (perimetritis).—Inflammatory affections of the pelvic peritoneum are, in the majority of cases, secondary to septic affections of the uterus and tubes. In many cases the infection is directly conveyed by the tubes, and may be due to gonorrhœa or septic endometritis; in other instances it is due to the implication of the serous layers of the mesometrium in pelvic cellulitis. Perforation of the uterus by a sound or attempted

abortion, and punctured wounds of the upper part of the vagina involving the recto-vaginal fossa, are also causes of septic peritonitis. Pelvic peritonitis occasionally follows surgical operations on the neck of the uterus.

It is only necessary to recapitulate the causes of pelvic peritonitis (perimetritis) here as the chief signs, diagnosis and modes of treatment are dealt with in connection with the various primary causes in the appropriate sections of this treatise.

Abnormalities of the canal of Nuck.—In the female fœtus a process of peritoneum directly continuous with the anterior layer of the mesometrium occupies the inguinal canal, and bears the same relation to the round ligament of the uterus as the funicular pouch bears to the vas deferens. In the adult female this pouch is normally obliterated. Frequently it remains patent and communicates with the general peritoneal cavity.

Under such conditions it may be occupied by a piece of omentum (epiplocele); or a knuckle of gut (enterocele); or an ovary (oöphorocele), with or without the Fallopian tube; or the Fallopian tube alone (salpingocele).

The communication with the peritoneal cavity may be occluded, but the pouch persist, and this will occasionally become distended with serous fluid. Under such conditions it forms a "hydrocele of the canal of Nuck," and may attain the size of a closed fist. A hydrocele of this character is apt to be confounded with a hydrocele of a hernial sac, and *vice versa*. Hydrocele of the funicular pouch of peritoneum is not uncommon in female infants.

THE DIFFERENTIAL DIAGNOSIS OF PELVIC SWELLINGS.

For clinical purposes pelvic swellings may be arranged in two categories:—

1. Swellings that rise out of the pelvis and occupy the belly—abdomino-pelvic swellings.
2. Swellings that remain in the cavity of the true pelvis—pelvic swellings.

1. Abdomino-pelvic swellings.—The conditions that come under this heading are: gravid uterus, uterine tumours, hydrometra, pyometra, large ovarian, parovarian, and paroöphoronic tumours, myoma of the mesometrium, large pyosalpinx, tubal pregnancy in its mesometric stage, and pelvic cellulitis and abscess.

The diagnosis and treatment of these conditions have been described in the preceding pages. (See also page 660.)

2. Pelvic swellings.—These do not rise above the pelvic brim, or are only detected by vaginal or rectal examination, and give rise to pain and irregularities of menstruation.

Pain.—This may be constant or paroxysmal; when paroxysmal it may be provoked by:—

- (a) Defecation.
- (b) Menstruation.
- (c) Coitus.

Irregularities of menstruation :—

- (a) The flow is too profuse—menorrhagia.
- (b) It may be too frequent—metrorrhagia.
- (c) It may be arrested—amenorrhœa.

When any of the above symptoms are complained of by married women, a careful physical examination of the pelvic organs should be made. In the case of single women, judgment should be exercised before resorting to it.

If on examination, an abnormal swelling is detected, it is necessary to determine whether it belongs to the uterus, broad ligaments, Fallopian tubes, ovaries, or some adjacent structure.

(1) **If the swelling is connected with the uterus, it may be :—**

- (a) Early pregnancy.
- (b) Retroverted gravid uterus.
- (c) Retroflexed uterus.
- (d) Hydros, pyo, or hamato-metra.
- (e) Myoma, impacted or free.

(2) **If the swelling is unilateral or bilateral, and appears to be connected with the broad ligament, it may be :—**

- (a) Cellulitis.
- (b) Abscess.
- (c) Hæmatoma.
- (d) Gestation sac.
- (e) Myoma.
- (f) Hydatid.

Here the history and general condition of the patient are very valuable. If the trouble has followed abortion or delivery it is probably due to pelvic cellulitis, and a little watching and waiting soon enable a correct diagnosis to be formed.

When signs of suppuration are absent, and there is pain, some fulness of the breasts and a history of sudden pelvic pain, followed by collapse, mesometric rupture of a gravid tube may be entertained, if the age and environment of the patient be favourable to this event. Such cases are sometimes associated with irregular bleeding and the expulsion of a decidua.

Myoma of the broad ligament cannot be diagnosed before operation from uterine myoma.

Immobility and pain in the swelling do not exclude the conditions of Group 1, because small ovarian dermoids are apt to be adherent and very painful, and myomata are occasionally so firmly impacted as to be immobile.

(3) **If the swelling is not adherent to the uterus or broad ligament—**

It may (A) belong to the ovary, and be :—

- (a) An inflamed ovary.
- (b) A small ovarian tumour.
- (c) A small parovarian cyst.

Or (B) it may be some affection of the Fallopian tube :—

- (a) Hydrosalpinx.
- (b) Pyosalpinx.
- (c) Gravid tube.
- (d) Tuberculous tube.
- (e) Tumour of the tube (myoma, adenoma).

It is difficult to formulate rules for discriminating between these conditions, but in a general way it may be stated that if the tumour be mobile, cause little pain except when pressed, and produce no disturbance of menstruation, it is exceedingly likely to belong to Group A.

In tuberculous salpingitis there is amenorrhœa, and usually evidence of tubercle in other organs.

In tubal pregnancy temporary amenorrhœa is the rule, followed by irregular bleeding from the uterus.

When Fallopian tubes are so enlarged as to rise above the brim of the pelvis, they are apt to be mistaken for ovarian tumours. When ovarian tumours are so small as to be restricted to the true pelvis, they are very apt to be regarded as distended tubes.

(4) **If the swelling is unconnected with uterus, tubes, ovaries, or mesometrium**, it may be :—

- (a) Fæces in the rectum.
- (b) Cancer of the colon or rectum.
- (c) Kidney in the hollow of the sacrum.
- (d) Tumour of the pelvic bones.
- (e) Post-rectal dermoid.

All these conditions have been mistaken for diseases of the ovaries or uterine appendages, and abdominal sections performed under this impression.

MALFORMATIONS OF THE FEMALE GENITALIA.

The adequate consideration of the defective development of the genital organs in the female is far beyond the scope and necessities of this treatise ; it is, however, necessary for practical purposes to mention the chief imperfections.

Bicorned uterus.—The uterus may be bifid (bicorned), each cornu opening separately into the vagina, and this passage may be divided by a vertical septum into a right and a left half. More commonly the cornua of a bifid uterus terminate in a median cervical canal, which opens into a normal vagina.

In both of the above-mentioned conditions the uterus is capable of performing its functions, and when one cornu is gravid, a decidua also forms in the unimpregnated cornu.

One-half of a bicorned uterus is very prone to be converted into a pyometra.

A very important variety of the bicorned uterus consists in one cornu progressing to full development, and the other with the associated ovary remaining rudimentary. Even an imperfect cornu may become gravid, and as the channel of communication with the vagina is too narrow to permit delivery, and the wall of the cornu is too small to accommodate the growing embryo, the condition is a grave one, the course of events being similar to that of pregnancy in a Fallopian tube, and is equally disastrous unless relief be afforded by art.

Malformation of the vagina.—The vagina, as already mentioned, may be completely divided into two lateral passages by a median septum. In many cases the septum may be deficient at the vulval extremity, so that the division only involves the uterine half, or even one-third of the vagina. Such a septum may hinder coitus, and the woman seeks relief on this account.

Occasionally the lower third of the vagina is deficient, and in exceptional instances the whole of the passage is absent. Such conditions are usually associated with defective development of the uterus. It is well to bear in mind that it is difficult to determine the absence of the uterus by means of rectal examination.

Minor defects in the vagina, unless they are associated with such malformations of the vulva as raise a doubt as to sex, are rarely detected until the girl approaches womanhood, then the delayed advent of the visible manifestations of menstruation leads to skilled inspection of the parts. Occasionally the defect is unobserved until attempts are made to consummate marriage. In many instances vaginal defects remain undiscovered throughout a long life. Some women, on the discovery of their imperfection, rest contented with their misfortune, but the majority seek relief; a certain proportion are bound to seek it, as the obstruction leads to such conditions as hæmatokolpos (page 1029), hæmatometra (page 1034), and to vesical troubles.

No rules can be framed for the treatment of vaginal deficiencies: much depends on the knowledge, skill, and enterprise of the surgeon, and the surroundings of the patient.

Hermaphroditism.—This term implies the combination in a single individual of functional male and female sexual organs. Adult males and females are distinguishable from each other by two sets of sexual characters, primary and secondary.

Primary sexual characters are those directly associated with the function of reproduction. These in the male include an intromittent organ, the penis; and two genital glands, the testes; and their ducts, the vasa deferentia.

In the female they comprise a passage for receiving the intromittent organ of the male, the vagina; two genital glands, the ovaries; two ducts, the Fallopian tubes for conducting the eggs

(ova) into the uterus, where they may be fertilised and retained for a definite period.

The early embryo possesses in a potential form the primary sexual organs of both sexes.

Secondary sexual characters are those features which enable the male to be distinguished from the female irrespective of the organs of reproduction, and those used for the nourishment or protection of the young.

The characters belonging to this group, so far as the human family is concerned, are mainly in the possession of the male. Man is distinguished from woman not only in the possession of a beard and greater muscular development, with its necessary accompaniment, greater physical strength, but he has a more powerful voice, and the skin of his trunk and limbs is thick and more abundantly supplied with coarse hair, which has a somewhat different disposition in women. In man the front of the chest is usually covered with hair. The hair on the pubes in the male passes upwards to the umbilicus, whereas in the female it is restricted to the pubes. A less constant feature, but one which seems confined to men, is a luxuriant growth of hair on the prominence of the pinna known as the tragus.

Secondary sexual characters are not present in the young, but become manifest at puberty, by which term we signify reproductive maturity. At this period the generative organs increase in size, and in the male become functionally active. In the female puberty is more strikingly declared by the institution of menstruation.

When the sexual characters come to be analysed it will be found that the essential element in both is the genital glands.

The term hermaphrodite, to be applicable to the human species in the same sense that it is employed by naturalists, would signify an individual possessing ovaries and testes (a combination occasionally met with in vertebrata, and known as an ova-testis), or an ovary on one side, and a testis on the other. There is no instance on record of these combinations in the human species, but the individuals to which the term hermaphrodite is usually applied are those in which there is defective development of the external genitals, and the secondary sexual characters are those of the female.

This condition should be termed **pseudo-hermaphrodisism**, and is one that requires the careful consideration of surgeons, because carelessness on their part may entail life-long misery on the individual.

In all cases of doubtful sex, the only means of absolutely determining it is by a histological examination of the genital gland. It is, of course, impossible in a general treatise of this kind to describe, or even classify, the various defects of the genitalia in pseudo-hermaphrodisism, but in the majority of pseudo-hermaphrodites the genital glands are testes, notwithstanding the fact that many of these individuals possess a uterus and Fallopian tubes.

Most pseudo-hermaphrodites are brought up as girls; this is a misfortune and a great injustice, for with the advent of puberty, which in these circumstances is often greatly delayed (it may remain wholly in abeyance), the supposed girl suddenly assumes the voice of a man, and begins to grow a beard.

It is a good rule for practitioners to bear in mind, that when there is doubt as to the sex of a child, and they are called upon to advise as to its upbringing, always to recommend that it should be named, trained, and educated as a boy.

THE END.

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